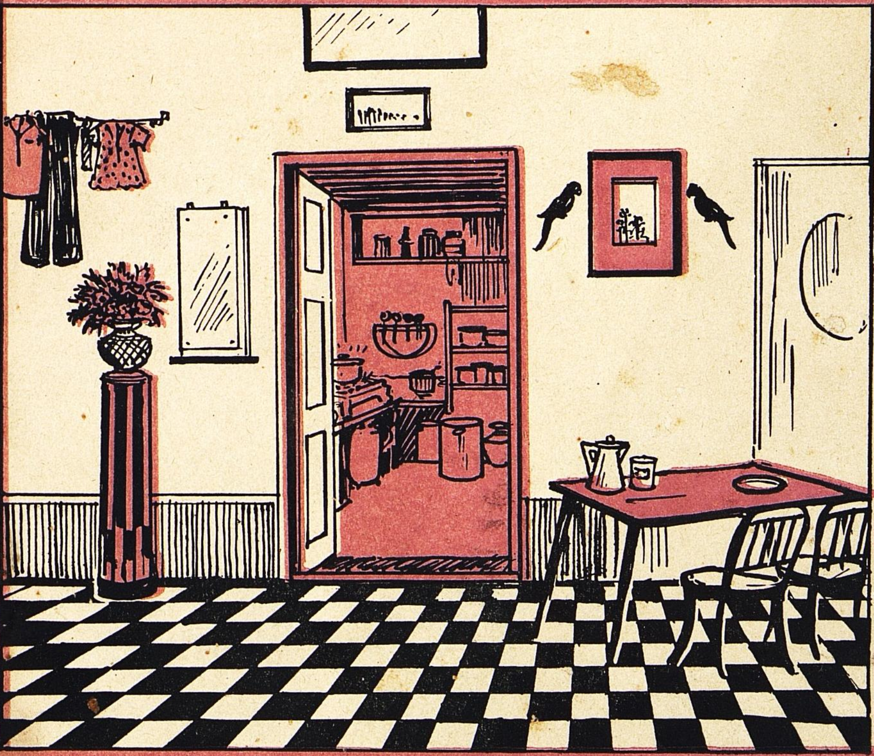
HOME SCIENCE

HIGHER SECONDARY – FIRST YEAR

Vol. I



TAMILNADU TEXTBOOK SOCIETY

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Higher Secondary – First Year

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(Further Chapters will be continued in Vol. II)

CHAPTER 1

Human Physiology

ANIMAL CELL

The cell can be defined as the unit of structure and function of a living body. There is no typical shape for the animal cell. Its size and shape vary considerably..

All cells are composed of a living substance called protoplasm. The protoplasm of each cell is bounded by a membrane called the plasma membrane. This is very thin, less than ten thousandth of a millimetre in thickness, and can be seen only under very high magnification. It controls the movement of substances passing into or out of the cell and is unique in that it allows certain substances to pass through freely but prevents or restricts the flow of others. Such a membrane is said to be selectively permeable. The selectivity of the cell membrane is lost when the cell dies.

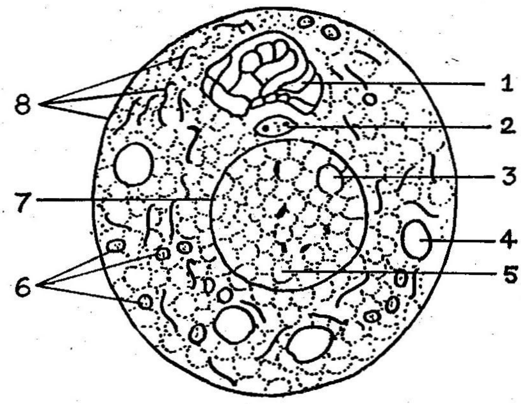


Fig. 1
Cell

1. Gogli Apparatus 2. Centro-Sphere 3. Nucleolus
4. Vacuole 5. Caryosome 6. Inclusion Bodies
7. Nucleus 8. Mitochondria.

The protoplasm consists of two very well defined parts—the cytoplasm and the nucleus. The cytoplasm is a translucent, watery or jelly-like material containing salts, fats, sugars, proteins and many other substances. It can sometimes be seen streaming about in the cell. The nucleus is a denser spherical body placed somewhere in the cytoplasm. It is also bounded by a delicate covering called the nuclear membrane. Within the nucleus there is a still denser structure, the nucleolus. The special substance constituting the nucleus is chromatin. This occurs in the form of long, thread like structures called the chromosomes. These threads usually occur as a confused network but, when the cell begins to divide, they can be traced as individuals. Every type of organism has a characteristic number of chromosomes in its cells. There are 46 chromosomes (23 pairs) in man.

The chromosomes bear many extremely minute particles, the genes, which control the characteristic form and growth of the organism. In other words, they are the carriers of hereditary characteristics. The nucleus controls and directs the work of the cell. Although the nucleus has a key role in the life of a cell, this does not mean that the rest of the cell (cytoplasm etc) is unimportant. Because of the presence of the genes inside it the nucleus is the control centre of the cell functions, while the cytoplasm is the executive centre. The nucleus cannot exist without the cytoplasm just as the cytoplasm cannot exist without the nucleus.

Electron microscope studies have shown that the structure of the cell is exceedingly complex. For example, a fine network called the endoplasmic reticulum extends throughout the cytoplasm and forms a sort of 'Skeleton' for the cell. The cytoplasm, which appears to be a homogeneous fluid mass under an ordinary microscope, also contains many other concrete constituents.

All cells contain hundreds of extremely small bodies called mitochondria. They are in the form of granules, globules, rod or threads. The mitochondria are the seat of breakdown of food materials in the cells resulting in the release of energy during respiration.

In most cells there also exist numerous cup-shaped structures called golgi bodies or golgi apparatus, named after their discoverer

Golgi. The function of these bodies is not known with certainty but some biologists think that they are concentrated with the process of secretion. Secretion means formation and giving out of a substance by the cell.

Some other extremely small particles called the microsomes or ribosomes are also present in the cytoplasm. These are important because protein synthesis takes place on their surface.

In the cytoplasm one may also find one or more small balloon-like spaces filled with a watery, non-cytoplasmic fluid. These areas are called vacuoles. The watery fluid of the vacuoles is called cell sap and is separated from the general cytoplasm by a delicate membrane, the tonoplast.

Cell Division

All cells grow and attain a maximum size. When they reach a maximum size they divide into two. Cell division is mainly of three kinds namely amitosis, mitosis and meiosis.

Amitosis

Amitosis is the simplest kind of cell division. In this kind of cell division the cell directly divides into two. Therefore it is known as direct cell division. The nucleus first elongates and divides directly into two. This is followed by the division of the cytoplasm. Amitosis takes place in certain unicellular animals and in the diseased parts of the animal body.

Mitosis

Mitosis takes place in the somatic parts of the animal body. Therefore it is also known as somatic division. In this kind of cell division the nucleus undergoes several changes and divides into two. Therefore it is known as indirect cell division. It involves two main processes namely karyokinesis and cytokinesis. During karyokinesis the nucleus divides into two daughter nuclei. During cytokinesis the cytoplasm divides into two by a construction between the two daughter nuclei, resulting in the formation of two daughter cells.

Mitosis takes place in four stages namely prophase, metaphase, anaphase and telophase.

(i) **Prophase:** The cell becomes turgid and spherical. The central body or centrosome divides into two bits. Radiating fibres appear around each bit. They are called astral rays. Each bit of the centrosome with the surrounding astral rays is called an aster. One aster remains stationary. The other moves to the opposite pole of the cell. In the meantime the chromatin reticulum splits into definite number of bits called chromosomes. Each chromosome splits lengthwise into two daughter chromosomes called chromatids. Then the chromosomes become shorter and thicker. Cytoplasmic fibres appear in between the asters forming spindle. In the meantime the nuclear membrane and the nucleoli disappear.

(ii) **Metaphase :** The chromosomes arrange themselves in the centre of the cell at equal distances from the two asters. The chromatids are clearly seen. They are attached to the cytoplasmic threads of the spindle.

(iii) **Anaphase :** The cytoplasmic threads contract and in each chromosome one chromatid moves towards one aster and the other towards the other aster.

(iv) **Telophase:** The chromatids which have reached the poles are reconstituted to form the chromatin reticulum. Nuclear membrane and nucleoli appear. Thus two daughter nuclei are formed, one in each pole of the cell. The spindle disappears.

Cytokinesis : A construction appears in the equatorial region in between the two daughter nuclei. It is at right angles to the spindle. It grows deep and divides the cytoplasm into two. Thus two daughter cells each with one nucleus are formed. The aster forms the centrosome of each daughter cell.

Significance : In mitosis the nuclear material of the mother cell is equally divided both qualitatively and quantitatively and distributed to the daughter cells, so much so the number of chromosomes in the daughter cells is exactly the same as the number in the mother cell.

3. Meiosis

During meiosis the cell divides twice producing four daughter cells, each with haploid number of chromosomes. In the first division the diploid number of chromosomes is reduced to haploid number. The second division is similar to mitosis so that the resulting daughter cells have the same haploid number.

Like mitosis it consists of four stages namely prophase, metaphase, anaphase and telophase.

(i) **Prophase :** Unlike the prophase of the mitotic division it is much prolonged and complicated. It is divided into five substages namely leptotene, zygotene, pachytene, diplotene and diakinesis.

(a) **Leptotene:** The centrosome splits into two and the asters are formed as in mitosis. Then one of the asters moves apart towards the opposite pole of the cell. The chromatin reticulum splits into definite number of chromosomes. The chromosomes are long and thin. They appear chainlike with beads of chromosomes. They are arranged like a boquet.

(b) **Zygotene:** We have already studied that the chromosomes are always in pairs. Each pair of chromosomes has the same size, shape and quality, of them one has come from the male parent. Such identical chromosomes are called homologous chromosomes. They now pair due to a force of attraction between them. The pairing of homologous chromosomes is called synapsis, and each pair is called a bivalent.

(c) **Pachytene :** The chromosomes become short and thick. Each one divides into two chromatids. However, the centromere does not divide. Thus each bivalent has four chromatids and is now called a tetravalent.

(d) **Diplotene :** The force of attraction between the homologous chromosomes now ends. Instead there is now a force of repulsion. However they do not separate completely but are attached at certain points. These points appear like letter 'X' and are called chiasmats. At these chiasmata an exchange of similar

parts of the chromatids of the homologous chromosomes takes place. This is known as crossing over.

(e) **Diakinesis :** The chiasmata disappear and the homologous chromosomes separate. They are now much shorter and thicker than before and are scattered throughout the nucleus. In the meantime the nuclear membrane and the nucleolus disappear. The spindle appears in between the two asters.

(ii) **Metaphase :** The chromosomes arrange themselves in the centre of the cell equidistant from the two asters. The spindle fibres attach themselves to the centromeres of the chromosomes.

(iii) **Anaphase:** During anaphase the spindle fibres contract. In each pair of homologous chromosomes one chromosome moves towards one aster and the other towards the other aster.

(iv) **Telophase :** The chromosomes which have reached each pole are organised into a daughter nucleus. Nuclear membrane and nucleoli appear, spindle disappears. The ytoplasm now divides into two. Thus two daughter cells each with haploid number of chromosomes are formed.

Meiotic Division

The second meiotic division takes place in each of the two daughter cells produced by the meiotic division. This is similar to mitosis and it also consists of four stages namely, prophase, metaphase, anaphase and telophase.

(i) **Prophase:** The chromosomes become distinct. Each chromosome has two chromatids which are held together by the centromere. Nuclear membrane and the nucleoli disappear. Asters and spindle are formed.

(ii) **Metaphase:** The chromosomes arrange themselves in a new equatorial plane at right angles to the original equatorial plane. The chromatids of each chromosome separate by the division of the centromere.

(iii) **Anaphase:** One chromatid in each chromosome moves towards one pole and the other towards the other pole by the contraction of the spindle fibres.

(iv) **Telophase:** The chromatids in each pole are reconstituted to form the chromatin reticulum. Nuclear membrane and the nucleoli appear. Spindle disappears. This is followed by the division of the cytoplasm into two. As each of the daughter cells produced by the meiotic division has divided into two, altogether four daughter cells are formed each with haploid number of chromosomes.

Differences between Mitosis and Meiosis

	Mitosis	Meiosis
1.	Takes place in the somatic parts of the body.	Takes place in the reproductive parts of the body.
2.	The cell divides only once, so that two daughter cells are formed.	The cell divides twice so that four daughter cells are formed.
3.	Daughter cells get the same number of chromosomes of the mother cell.	Daughter cells get only half the number of chromosomes of the mother cell.
4.	Prophase is short and simple.	Prophase of the meiotic division is a complicated process involving a number of subphases.
5.	Homologous chromosomes do not pair.	Homologous chromosomes pair.
6.	There is no exchange of the similar parts of the chromatids.	There is an exchange of the similar parts of the chromatids of the homologous chromosomes.

7. Centromere divides during metaphase so that each chromosome is completely split into two chromatids.	Centromere does not divide during the metaphase so that the chromosome is not completely split into two chromatids.
8. During anaphase, one chromatid of each chromosome moves towards one pole and the other towards the other pole.	During anaphase of the meiotic division full chromosomes of a homologous pair move to opposite poles.

Formation of Tissue, Organ and System

The cells in the body of the multicellular animals vary in structure and function. It is seen that one variety of cell performs one kind of work and constitutes one type of tissue. So a tissue may be defined as an aggregate of same type of cells combined by subserving the same general function independently and united by varying amounts of inter cellular substance. An organ is a group of more commonly two or more tissues which basically function independently in some instances in particular patterns to form larger functional units. e. g., blood vessels, kidney, skin, glands etc. When several organs function inter relatdely they form organ system. e.g. respiratory system comprising the nose, larynx, trachea and lungs, urinary system comprising kidney, urethra and ureters. This arrangement, based upon the principle of division of labour is an essential requirement for co-ordinated living. One group of cells is set apart for one function and will specialise for the job. During the initial stages of embryological development the cells are all similar. As development proceeds one group of cells takes up one particular work and in order to perform the work in the best possible way it undergoes the necessary change in structure and mode of life. The process of adoptation of a cell for the purpose of doing a particular function is called differentiation or specialisation. The fertilised ovum divides first into two cells, these again into two more and so on until a large mass of embryonic cells are formed. The first few cells are believed to be potent which means that, each one of them has got potency of creating a total individual. The first evidence of differentiation is found in this cellular mass, where the cells become arranged

in three distinct layers, known as the ectoderm, mesoderm and the endoderm. The following tissues in general are derived from the three layers.

Ectoderm—epithelium of mouth, nose, anterior surface of cornea, external auditory canal, skin, hair, urethra, sweat gland, sebaceous gland, mammary gland, pituitary, adrenal medulla, brain, cranial nerves etc. Mesoderm—connective tissue including blood and bone marrow cells, the three different kinds of muscle in general, lymphatic organs, endothelium of blood vessels, epithelium of urinogenital tracts and the adrenal cortex. Endoderm — epithelium of the digestive and respiratory tract bladder, thyroid, parathyroid and the thymus.

TISSUES

The tissues of animals may be classified into four major groups: (1) Epithelial or Covering tissue, (2) Muscular or Contractile tissue, (3) Connective or Supporting tissue and (4) Nervous tissue.

(1) Epithelial or Covering Tissue

The epithelial tissue forms the outer protective covering all over the body, and lines the inside of all cavities such as those of

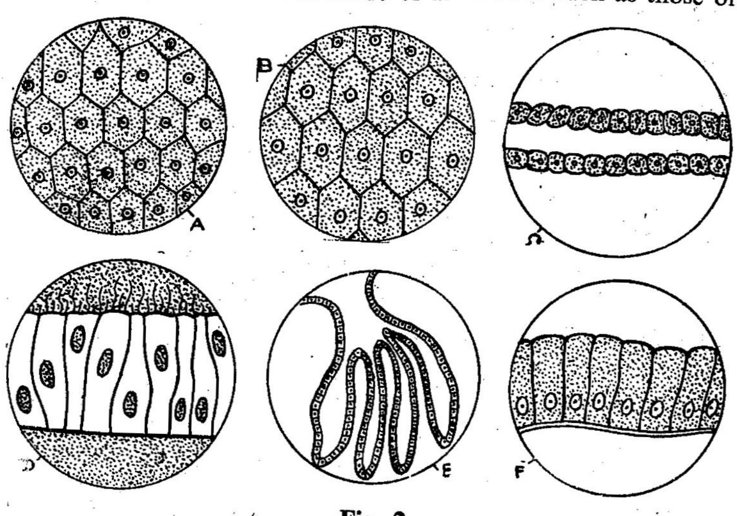


Fig. 2
Kinds of Tissues

A. Epithelial Tissue B. Squamous Tissue C. Cuboidal Tissuee
D. Ciliated Tissue E. Glandular Tissue F. Columnar Tissue

the stomach, intestines, mouth, throat and windpipe. Some epithelial cells can secrete drops of mucus, a slimy substance that lubricates the nose and throat. Such a secretary epithelial tissue is known as mucous membrane.

Cells lining the stomach secrete a digestive fluid. Often the secretary epithelial cells are aggregated into special areas called glands. As examples may be cited the sweat glands and oil glands of the skin and the salivary glands in the mouth. The epithelial tissues may be simple, i.e., composed of a single layer of cells, or it may be stratified, i.e., made of several layers. The shapes of the cells composing this tissue vary a great deal. The epithelial tissue of the skin, which protects the flesh beneath, has broad, flat cells resembling tiles in a pavement. There are no spaces between these cells, so that the skin can peel off in layers. The epithelial cells lining the respiratory passages bear numerous hair-like structures called cilia which make lashing movement and tend to sweep germs out of the air passage. Some epithelial cells of the skin may become specilized to receive external stimuli. Such sensory cells are found, for example, in the bodies of earthworms.

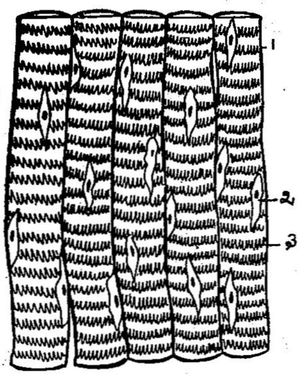


Fig. 3
Striped Muscle
1. Sarcolemma
2. Nucleus 3. Striations

(2) Muscular or Contractile Tissue

Do you know that your body has more than 600 muscles which control the various movements? Since all animal life is charac-

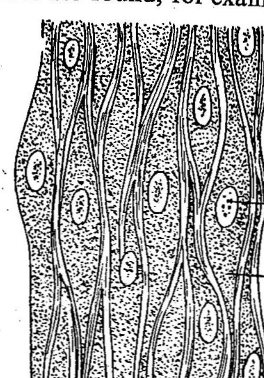


Fig. 4
Non-striped Muscle
1. Nucleus 2. Granules

terized by movements, this tissue plays an important part in the life of the organism. Tissues composing muscles are of three types: Unstriated, striated and cardiac.

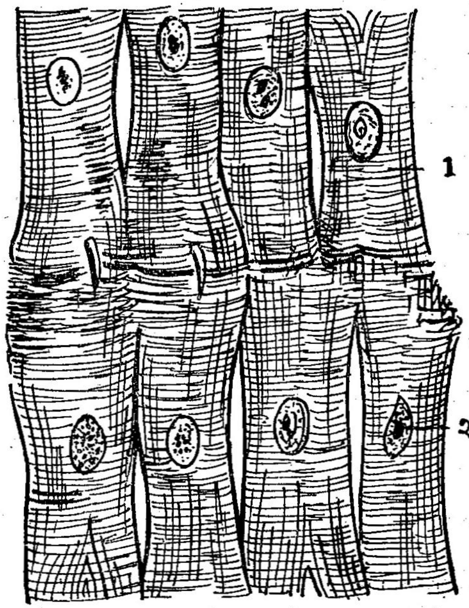


Fig. 5
Cardiac Muscle
1. Striations 2. Nucleus

Unstriated (also called smooth, involuntary or Visceral) muscles have narrow, spindle-shaped, uninucleate cells. These are called involuntary muscles because, their movements are not controlled by the mind. Such muscles are found in many internal organs such as the stomach and intestine whereby they help to push the food along the alimentary canal. They are also found in smaller blood vessels, breathing passages and the organs concerned with urination and reproduction. These muscles contract and relax very slowly.

Striated (also called voluntary, striped or skeletal) muscles are made of long cylindrical fibres each having many nuclei enclosed in a thin membrane. Striated muscle fibres

form groups or bundles which run parallel to each other. They bear cross bands or striations visible under the microscope. They are just alternating light and dark bands placed at right angles to the long axis. Flesh is made mostly of these muscles. They form nearly 50 per cent of the entire body. They can contract rapidly and are responsible for the quick movements found in animals. Not all the fibres of a muscle contract at the same time and the strength of contraction of the muscle is attached to a bone, the bone will also move whenever the muscle contracts. The contraction of muscles is controlled by nerves that are richly distributed in them. These muscles are called voluntary because their action is regulated by mind or will.

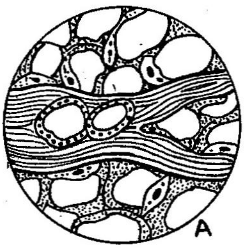
Cardiac muscles are found only in the heart. Though striated, they are involuntary, i.e., not under the control of one's will. Your heart beats throughout your life on its own and cannot be controlled by your will. The fibres composing heart muscles are branched and form a close network.

(3) Connective or Supporting Tissue

This tissue, as the name indicates, serves to bind the cells of other tissues and to give them rigidity and support. It is composed of ordinary cells and numerous tiny, rope-like structures called fibres. The cells secrete a ground substance or matrix in which they are embedded.

Fibrous connective tissue contains rows of flattened cells distributed throughout a gelatinous matrix and mesh of delicate fibres. There are two kinds of fibres—the white ones which are non-elastic, unbranched and united into bundles and the yellow elastic fibres which occur singly but are branched extensively to form a net work. The white fibrous tissue is tough and forms the tendons, ligaments and coverings of muscles. Tendons serve to attach muscles to the bones. Ligaments are bands of tissue that hold the bones together. The yellow fibrous tissue is found in the walls of the arteries and lungs. It also binds the skin to the muscles underneath it. Fibrous tissue is thus mainly a binding tissue.

The adipose or fat tissue contains cells filled with fat globules and surrounded by a matrix of yellow and white fibres. It occurs in the deeper parts of the skin, in the bone marrow and around certain organs. It is, therefore, a filling tissue.



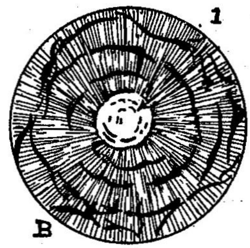


Fig. 6-A Fig. 6-B

Connective Tissues

Fat Tissue Bone Tissue

Cartilage is another connective tissue that covers the ends of bones and gives support to certain organs such as the nose, ear, food-pipes and wind-pipes. It consists of a clear ground substance or matrix which contains a large number of spaces, each occupied by one or several cells. The elastic cartilage of the ear contains a large number of fibres in addition to cells. Bones, the chief supporting structures of vertebrates, are also a type of connective tissue. They have been cells embedded in a hard matrix of calcium and phosphorus salts. This deposition is in the form of thin concentric layers around a central canal. The bone cells occupy small spaces which are connected to one another by a system of radiating canals.

The longer bones have a central hollow cavity filled with bone marrow which is made of fat cells and red as well as white blood cells. The bones are surrounded by a membrane of connective tissue which carries nerves and blood vessels.

Blood is also a kind of specialized connective tissue which carries food materials and oxygen to all parts of the body. It consists of a fluid medium or plasma with numerous red as well as white blood cells (corpuscles) and platelets

floating in it. The fibres that are so common in other types of connective tissue are only potentially present in the form of a blood protein called fibrinogen. When the blood clots, the fibrinogen is precipitated into protein fibres.

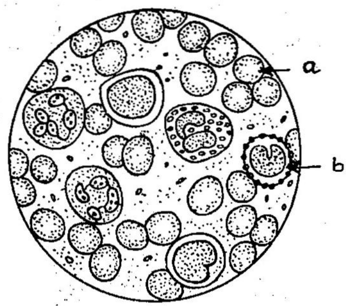


Fig. 7

Blood Corpuscles

a. Red Blood Corpuscles b. White Blood Corpuscles

(4) Nervous Tissue

This is a very specialized tissue that serves to receive and conduct sensations, and to stimulate other tissues to activity. It is made by nerve cells which convey messages from one cell to the next. A nerve cell or a neuron consists of a main body from which numerous, delicate, thread-like fibres are given out. Most nerve cells have fibres of two kinds—the thinner ones or dendrites which carry sensations to the cell; and a thicker one or axon which carries the messages away from the cell. The nerve cells are located in the brain and spinal card from where nerve fibres branch out to every part of the body. Some of these fibres may be over a metre in length. The nerves in our bodies are like cables made of many nerve cell fibres bound together by a sheath of connective tissue.

BLOOD

Blood is a tissue which is found only in the higher animals and performs some important functions. It is the vehicle which carries the oxygen, water and food material necessary to the tissues and transports carbon dioxide and products of metabolism away from these cells. The harmones produced by the endocrine glands reach the target organs through blood. The blood has a protective function which is exerted by the white blood corpuscles, which fights the bacteria entering the body. Pus is the dead matter composed of the destroyed white blood corpuscles. The protein of

the blood also produces antibodies. The blood also helps in the maintenance of the acid base balance and in the even distribution of heat.

Composition of Blood

Blood consists of a straw fluid called plasma in which the formed elements are suspended. Formed elements are called blood corpuscles. Plasma constitutes about 55% and the cells about 45% of the total volume of human blood. The plasma is composed mainly of water with 7% of proteins which has very important functions to perform. The proteins are albumin, globulin and fibrinogen. Plasma also contains substances like glucose, sodium, potassium chloride and many other ions, besides urea, uric acid and cholesterol.

Formed elements

The red blood cells or R.B.C are the most important in the group.

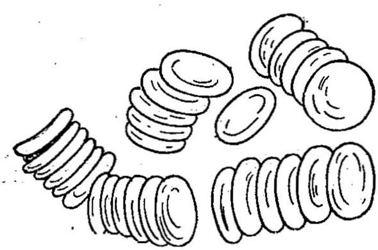


Fig. 8

Erythrocytes in Rouleaux

They are also called erythrocytes. Large numbers to the extent of 5 million are seen in 1 cu. mm of blood. Each R.B.C is a disc shaped biconcave structure. When seen from the side it has a dumb-bell shaped appearance. The R.B.C have a tendency to stick to one another like a pile of coins known as "rouleaux formation". R.B.C contain red pigment, known as haemoglobin. About 100 ml. of blood will contain about 15 gms of haemoglobin.

Any condition in which the amount of haemoglobin in the blood is reduced is known as anaemia.

White Blood Corpuscle

The W.B.C. are called leucocytes. There are only abut 5000 to 8000 W.B.C. cu.mm of blood. There are different types of W.B.C. They are neutrophils, basophils, eosinophils, lymphocytes and monocytes.

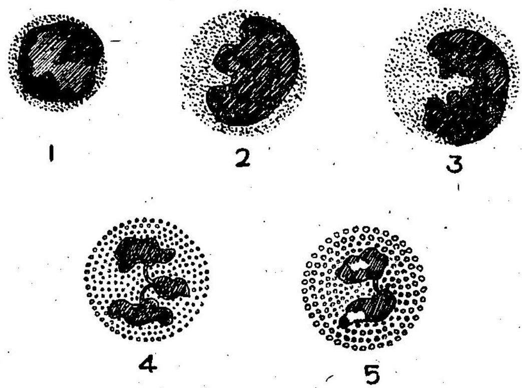


Fig. 9

White Blood Corpuscles

1. Small Lymphocyte 2. Large Lymphocyte
3. Monocyte 4. Neutrophil 5. Eosinophil

Platelets

These are very small bodies present along with W.B.C. and R.B.C. in blood. They are about 2 lakhs to 5 lakhs of platelets cu.mm of blood. The platelets are extremely useful in the process of coagulation.

Normal human body contains about five litres of blood. Blood is normally a fluid when it is inside the body. But when blood is shed it looses its fluidity within few minutes and set into a semi-solid jelly. This phenomena is known as coagulation.

Blood transfusion

When more than 40 per cent of the blood is lost over a short period of time, the body is usually unable to repair the loss unaided. Some artificial means of replacing the lost fluid must be resorted to. The intravenous injection of blood is known as blood transfusion.

Blood groups

For a long time physicians have been wanting to give blood transfusion in order to save patients in cases of haemorrhage. Somehow or other this was not possible as transfusion invariably tended to produce severe reactions. Transfusion was successful to a certain extent in animals, but this success could not be repeated in human cases. Though a few stray cases of successful transfusions were reported like the famous instance of the gynaecologist. Blundell Spence who successfully transfused a case of haemorrhage after childbirth, the process was altogether too hazardous to undertake. It was the remarkable work of Karl Landsteiner and his colleagues which put transfusion on a rational scientific pooling. He put forward the theory that transfusion reaction were mostly due to the presence of agglutinogens and agglutinine in blood. The agglutinogens are found inside the R.B.C. There are really two powerful agglutinogens A and B and two corresponding agglutinin called alpha (α) and (β) beta which are found in plasma. All human beings can be divided into four groups namely A, B, AB and O. The R.B.C of group 'O' people do not contain any strong agglutinogen as 'O' agglutinogen is practically inactive. Thus 'A' group people cannot give blood to 'B' group persons and vice versa. 'AB' group cannot give blood to either A or B but can receive from any group as their serum is deficient of any agglutinins. They are called universal recipients. 'O' group on the other hand can give blood to anybody and are termed universal donors.

Rh factor

After the ABO Blood groups became well established it was found that certain transfusions which were done in conformity

with traditional blood groups still caused servere reactions. This problem was worked out and it was found that the transfusion reactions were due to the existence of another agglutinogen called Rh factor. This is called by the first two letter of the word 'Rhesus' as it was seen first in Rhesus monkey, 85% of Westerners are Rh positive while about 15% are Rh negative.

If Rh+ve blood is transfused to an Rh+ve individual there is no immediate reaction. But the Rh—ve person develops Anti-Rh agglutinins and a second transfusion may produce disastrous results. Supposing the father is Rh+ve and the mother is Rh—ve then they may have an Rh+ve or Rh—ve child. If the child is Rh+ve there is every possibility that when the child's blood enters the mother's circulation it might produce an anti-Rh substance. When it recirculates in the foetus it can cause haemolysis. Normally the first child is spared and with subsequent pregnancies there is a danger of haemolytic reactions and the child being born with severe jaundice. Such a condition is called 'Erythroblastosis foetalis.'

Several other groups like M, N and P are known. These groups have no clinical importance. But they are sometimes used as medico legal evidence in disputed patency.

THE LYMPHATIC SYSTEM

Tissue fluid is derived from blood plasma, by process of diffusion and filtration. This fluid occupies the intracellular spaces and constitutes the internal environment of the body. Lymph is a modified tissue fluid. Lymphatic vessels arise as blind tubes in the intercellular spaces. These capillaries repeatedly join together to form bigger lymphatic vessels which pass through the lymph nodes receive more tributaries and gradually increase in size. All the lymph from the body is finally collected into two big channels - the right lymphatic duct and the thoracic duct which open respectively at the right and left subclavian veins. The primary lymphatic vessels that remain in the centre of small intestinal villi are known as lacteals and during the course of digestion lacteals are filled with milk white fluid, chyle. Lymphatics are not present in the central nervous system or the bone marrow.

Functions of Lymph

1. Lymph forms the medium for the interchange of oxygen and carbon dioxide and also for taking in the products of digestion and sending out the waste products of metabolism from the blood to the tissue cells and vice versa.

2. It acts as an alternative drainage system for the cells and takes in salt and extra vascular protein.

3. It is part of the reticulo-endothelial system and helps in the defence of the body against invading bacteria from outside. The lymph glands are small aggregation of cells placed in the course of lymph vessels. It is these glands which are inflamed and enlarged in inflammations and infections of the different parts of the body.

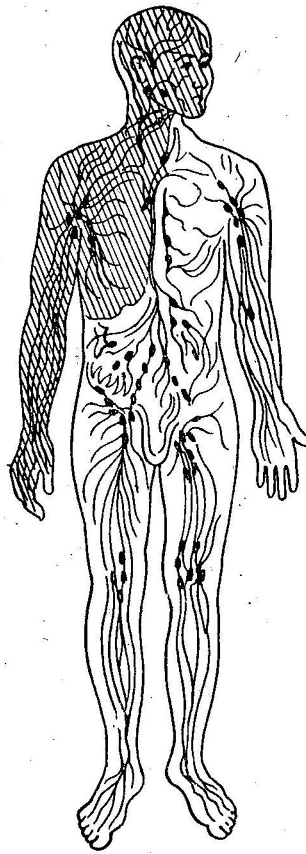


Fig. 10
Lymphatic System

CARDIO-VASCULAR SYSTEM

Structure of the Heart

The human heart consists of four chambers, that is two auricles and two ventricles. The auricles are thin walled chambers placed above the ventricles which have thick walls. The right auricle receives venous blood from the great veins namely the superior vena cava and inferior vena cava and diverts it to the right ventricle.

The wall of the right ventricle is comparatively thinner than the left ventricle as it has to pump blood only through the pulmonary circuit. The blood after oxygenation is returned to the left auricle and in turn sent to the ventricle. The wall of the left ventricle is very thick as it has to pump the blood through the systemic circulation to the entire body.

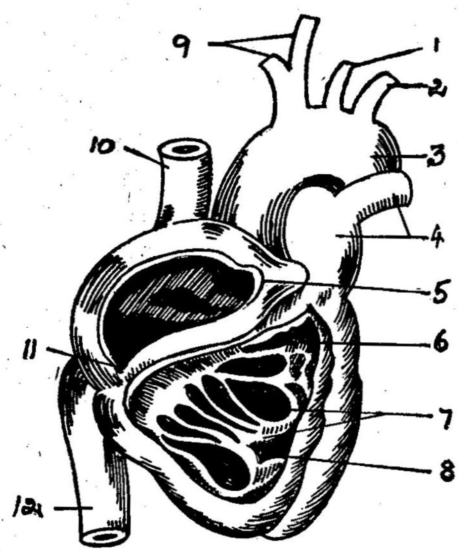


Fig. 11

Heart - Longitudinal Section

1. Left Pulmonary Artery
2. Left Sub-clevian Artery
3. Aorta
4. Pulmonary Artery
5. Auricles
6. Pulmonary Valve
7. Muscular Fibres
8. Ventricles
9. Right Sub-clavian Artery
10. Superior Venacava
11. Auriculo Ventricular Valves
12. Inferior Venacava

The functioning of the pump is dependent on the existence of valves which allow the passage of blood only in one direction. The mouths of the pulmonary artery and aorta are guarded by

semilunar valves which allow the passage of blood only into the vessels and do not permit any regurgitation. The right auricle and ventricle are separated by a tricuspid valve which allows blood only to enter from the auricle to the ventricle. There is a similar valve on the left side which has only two cusps and is called the bicuspid valve. It is also known as the mitral valve because of its resemblance to a bishop's mitre. The cusps of the atrio ventricular valves are anchored to the ventricular muscle wall by strings called chordaetendineae which are attached to muscular papillae.

Layers of the Heart Wall

The heart is a hollow organ the walls of which are made up of three different layers: (1) Endocardium-This membrane lines the interior of the heart and also is the material of which the valves of the heart are formed. (2) Myocardium—which is the muscle of the heart and is much the thickest layer. (3) Pericardium which forms the outermost layer of the heart wall as well as serving as the lining of the pericardial sac.

The cardiac muscle shares the properties of excitability and contractility. The property of rhythmicity which the cardiac muscle exhibits is unique. It beats at a specific rate because of this property, the rate in man being about 70 to 80/minute. This rate can be changed by many factors. The influence of temperature on the heart rate is well illustrated by the rise seen in fever. Temperature and heart rate are directly proportional to one another-heat increases it, cold depresses it. Similarly the heart rate changes when there is a change in the carbon dioxide and oxygen tension of the blood or its pH. Apart from these factors the heart rate is also controlled by the nerves supplying heart.

Blood Pressure

Blood pressure is defined as the lateral pressure exerted by the column of blood on the arterial wall. This is the pressure which drives the blood through the vascular channels and brings it back to the right side of the heart. Therefore the pressure

should be high on the arterial side and should show a fall in the subsequent sections till it reaches the minimal valve in the big veins. Though the discovery of circulation itself was made by William Harvey in 1623, the existance of a high pressure in the arterial system was demonstrated only in 1733 by Rev. Stephen Riva Rocci. He constructed the sphygmomanometer for measurement of the blood pressure in man. The blood pressure depends on four factors. They are cardiac out put or the amount of blood pumped by the heart, the peripheral resistance offered by the blood vessels, the viscosity of the blood and the fullness of the vascular systems.

Coagulation of Blood

When blood is shed it loses its fluidity in a few minutes and sets into a semisolid jelly. This phenomenon is called coagulation or clotting. On further keeping the clot retracts to a smaller volume and presses out a clear straw coloured fluid called the serum. Serum will not clot any more.

When the process of coagulation is studied under the microscope, it is seen that minute granules appear at first. These granules join together to form needles which again unite with one another to form long threads. These threads cross one another and form a sort of network, into the meshes of which the red and white cells become entangled. The clot gradually retracts and serum separates out.

It is to be noted that coagulation is the property of plasma alone. The red and white cells do not take part in it. They only become caught up in the meshes of the clot and are removed.

Normal coagulation time varies from 3 to 8 minutes.

Mechanism of Coagulation

Morawitz described the basic facts about the mechanism of blood clotting in the following manner. When blood is shed, the platelet (by coming in contact with rough surface)

disintegrate and liberate thromboplastin. Certain amount of thromboplastin is also derived from the damaged tissues of the injured locality. Thromboplastin converts prothrombin into thrombin with the help of calcium ions and thrombin interacts with fibrinogen forming fibrin. This is the clot. This can be summarised in the following step.

(1) Thromboplastin + calcium ions + prothrombin — thrombin

(2) Thrombin + fibrinogen — fibrin (clot)

Since 1940 research work has indicated that the clotting mechanism is a complex process. In 1954 an international committee was established. This committee suggested an international system of nomenclature time to time with the appearance of new factors.

Clotting Factors

I	Fibrinogen
II	Prothrombin
III	Tissue Thromboplastin
IV	Calcium
V	Labile factor or Proaccelerin
VI	Accelerin
VII	Stable factor or Proconvertin
VIII	Anti haemophilic factor
IX	Plasma Thromboplastin Component (PTC) or Christimas factor
X	Stuart factor
XI	Plasma Thromboplastin Antecedent (PTA) or Anti haemophilic factor
XII	Hageman factor
XIII	Fibrin Stabilising factor or Fibrinase

Factor I (Fibrinogen): It is a soluble plasma protein which is acted upon by thrombin to form insoluble fibrin clot. In the absence of fibrinogen clotting does not occur.

Factor II (Prothrombin): This inactive precursor of thrombin is formed in the liver and is decreased in hepatic disease. Its formation depends on the presence of vitamin K. It is converted to the proteolytic enzyme thrombin by prothrombin activator or thromboplastin.

Factor III (Thromboplastin): This converts prothrombin to thrombin in the presence of factors V, VII & X, Ca and phospholipid. This is formed in two ways.

Factor IV (Calcium): Calcium is essential for clotting. It is required for the formation of prothrombin activator, for conversion of prothrombin to thrombin and for the formation of insoluble fibrin clot.

Factor V (Labile factor): This factor is required for conversion of prothrombin to thrombin by tissue extract and plasma factor of blood constitutents. In both cases the key reaction is the conversion of factor X to its active form Xa. Factor Xa then interacts with factor V and phospholipid to form prothrombin activator.

Factor VI (Accelerin) This factor is a hypothetical activation of proaccelerin (Factor V).

Factor VII (Stable factor)—This factor is required for the formation of prothrombin activator by tissue extract.

Factor VIII (Anti haemophilic factor): Classical haemophilia is due to the congenital absence of this factor. This is required for the formation of prothrombin activator.

Factor IX (Christimas factor): It is needed for the formation of prothrombin activator.

Factor X (Stuart factor): This is essential for the formation of prothrobin activator.

Factor XI (Plasma Thromboplastin Antecedent): It is required for formation of prothrombin activator from blood constituents.

Factor XII Hageman factor): It takes part in the formation of prothrombin activator from blood constituents.

Factor XIII (Fibrin Stabilising factor): This is a plasma protein which causes polymerization of soluble fibrin to produce insoluble fibrin.

Platelets contain phospholipids which are essential for clotting in the absence of tissue extract.

Prothrombin activator or Thromboplastin is formed in two main ways, one as the result of tissue damage (extrinsic system) and the other due to interaction between different plasma factors intrinsic.

In the extrinsic system the reactions are as follows :

Tissue extract + Factor VII → VII a

↙ Ca ††

Factor X → X a

↙ Ca ††

Factor V → V a

↓

V a † X a † Phospholipid

↓

Prothrombin activator

Extrinsic Coagulation

In the extrinsic system the reactions leading to the formation Xa are more complicated and take several minutes for completion. Macfarlane has proposed an enzyme casoade hypothesis to explain the sequence of reactions involved.

Enzyme cascade Hypothesis: Macfarlane suggests that surface contact induces a sequence of changes in which an inactive precursor is converted to an active enzyme which then acts in the next procusor to form the next active enzyme and so on as set out in the diagram.

XII Surface contact XII a
↓
XI → XI a
↓
IX → IX a
↓
VIII → VIII a
↙
X → V → Phospholipid
Intrinsic thromboplastin

INTRINSIC COAGULATION

Thus the clotting mechanism of the intrinsic system is regarded as a series of enzyme substrate reactions leading to the formation of Xa which then acts in the same way as the extrinsic system.

Arteries

Arteries carry blood from heart to the tissues. Each artery is made up of three layers. The outer layer is made up of fibrous tissue and elastic tissue (tunica adventitia). The middle layer is made up of plain muscles and a network of elastic fibres (tunica media) and the inner layer of endothelium (tunica intima). In the arteries tunica adventitia and tunica media are very thick because they have to withstand considerable blood pressure. A special system of vessels—the vasa vasorum—passes into the arterial wall to supply these two layers. The intima layer consists of a single layer of endothelium, set upon a basement membrane of elastic tissue known as elastic lamina. This lamina is thrown into folds to prevent injury to the endothelial lining as may occur owing to pulsation.

Capillaries

Capillaries consist of a single coat—the intima only, having a single layer of flat endothelial cells. Obviously this is highly suitable for filtration, diffusion, osmosis etc. Lying upon the outer surface of the capillary wall is a peculiar type of branching cell known as Rouget cell. Their branches join with one another forming a network around the capillaries. These cells are supposed to be the modified muscle cells being the remnants of tunica media. By their contraction and relaxation the size of the capillaries can be altered.

Veins

Veins carry blood to heart. Each vein is made up of tunica adventia, tunica media and tunica intima similar to that of arteries. But tunica adventia and media are not very thick as arteries. They are present in much smaller quantities. At intervals the intima is thrown out into transverse folds and constitute a sort of incomplete valve. This helps to make the circulation one way, by allowing blood to flow towards heart but not in the opposite direction.

The Work of the Heart

Although the right and the left sides of the heart are completely separated from each other they work together. The blood is squeezed through the chambers by a contraction of heart muscle beginning in the thin walled upper chambers the atria and followed by a contraction of the thick muscle of the lower chambers the ventricles. This active phase is called systole and in each case it is followed by a short resting period known as diastole. The contraction of the walls of the atria is completed at the time the contraction of the ventricles begins. Thus the resting phase (diastole) begins in the atria at the sametime as the contraction (systole) begins in the ventricles. As soon as the ventricles have emptied, the atria contract while the ventricles relax and again fill with blood. Then the ventricular systole begins.

Heart Sounds and Murmur

The normal heart sounds are usually described by the two syllables 'lubb' and 'dupp'. The first is a longer and lower-pitched

sound which occurs during the ventricular systole. It is caused by the closure of the atrioventricular valves. The second or 'dupp' sound is shorter and sharper. It occurs at the beginning of ventricular relaxation and is due to the sudden closure of semilunar valves. The normal nature of the rhythm of the sound is a factor looked for in cardiac examination. In valvular diseases, where there is either a narrowing of the passages or regurgitation due to widening of the passage, the character of the sound is altered and it may be replaced by a murmur.

THE SKELETAL SYSTEM

The human body is built upon external framework of bones called, the skeleton. Actually bone is a specialized type of connective tissue which is reinforced by calcium to give it strength and solidity. The skeletal system may be divided into an axial portion consisting of the skull, vertebrae, the chest bones and the pelvic bones, and (b) an appendicular portion consisting of the framework of the limbs.

The Skull

The bones which form the cranium are flat bones which are immovably fixed to each other by sutures. The frontal bone is in front. The parietal bones form the lateral part of the cranium, with the temporal bones below the parietals. The posterior portion of the cranium is constituted by the occipital bone. There is a big opening on the lower aspect of the cranium called the 'foramen magnum' through which the spinal cord enters the brain. Apart from the bones forming the cranium there are bones which are part of the face and provide cavities for lodging the organs of the special senses. The only bone in the head which is movably articulated is the 'mandible' which forms the floor of the mouth. Both the maxilla and mandible have sockets, which carry the teeth.

The skull is placed on top of the vertebral column. The vertebral column is composed of 33 vertebrae which can be

divided into cervical (seven), thoracic (twelve), lumbar (five), sacral (five) and coccygeal (four) portions. Each of these groups have their characteristic features. Of these the first two cervical vertebrae are different from the rest of the cervical group. The

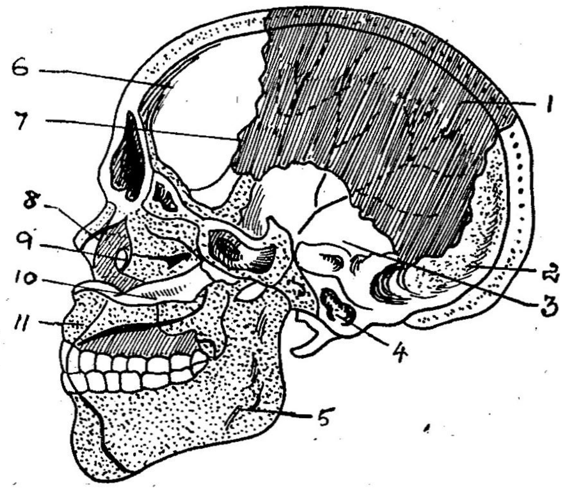


Fig. 12
Skull-Side View

1. Parietal Bone
2. Occipital Bone
3. Temporal Bone
4. Eustacian canal
5. Mandible
6. Frontal Bone
7. Sphenoid Bone
8. Nasal
9. Cerbital
10. Zygomatic Bone
11. Maxilla

Atlas is a mere ring of bone with surfaces for resting the skull. The second cervical vertebra is the **Axis.** It has an upward projection called the 'odontoid process' which projects through the ring of the Atlas and forms a pivot on which the head can turn from side to side. The skeletal frame work of the neck consists of five cervical vertebrae which are designed in the shape of flat discs placed one on the other.

The thoracic region contains 12 vertebrae. These differ from all other parts of the vertebral column in that here are attached 12 pairs of ribs.

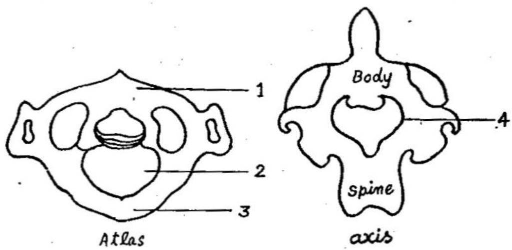


Fig. 13

1. Anterior Arch 2., 4. Neural canal
3. Posterior Arch

The lumbar area, which is usually curved inward contains five large vertebrae. The sacral portion is made up of five vertebrae. This serves to complete the framework of the pelvic girdle at the back. The coccygeal or tail part has four or five vertebral

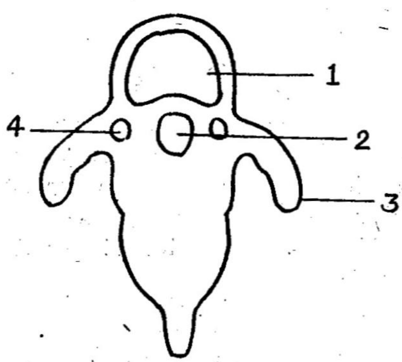


Fig. 14

Coccyx

1. Body 2. Spinal canal
3. Traverse Process 4. Articular Feed

bones in the child, but these fuse to form a single coccyx in the adult.

These vertebrae are like discs placed one on the other, forming a column. The hollow rings of the vertebrae also form a canal which lodges the spinal cord. The vertebrae are so articulated to one another, that while they give a rigid support, they also allow limited movement.

The limbs are attached to the axial skeleton. The upper extremity is attached to the bony cage of the chest of the shoulder girdle, which consists of the Scapula behind and the Clavicle in front. The most proximal bone of the upper extremity is the Humerus which articulates with Scapula. The lower arm consists of two bones. They are the Radius which is at the outer and to the Ulna which is inside.

The hand is made up of a large number of bones. Eight carpal bones constitute the wrist joint, while the metacarpals form the bony framework of the palms. Fourteen phalangeal bones form the fingers, two for the thumb and three each for the other fingers.

The pattern of formation of the lower limbs is also basically the same as the upper limbs. The hip joint by which the lower extremity is attached to the pelvic girdle is formed by the Acetabular cavity of the Ilium and the head of the Femur which is the largest bone in the body. The lower end of the Femur articulates with the upper end of the tibia which is the main bone in the lower leg. The fibula is a thin slender bone on the outside of the tibia. The bony framework of the leg is exactly similar to that of the hand, the tarsals and metatarsals replacing the carpals and metacarpals.

The Joints of the Skeleton

The joints in the human body are of three categories. They are (a) immovable (b) slightly movable and (c) freely movable joints. A typical example of the immovable joints are those formed by the flat bones of the cranium, which interlock with one another by their serrated edges. The intervertebral discs are examples for the slightly movable joints, where only restricted movement is possible. The freely movable joints are found in the extremities.

Freely Movable Joints

The freely movable joints can be subdivided into four categories. They are:

1. Hinge joint
2. Ball and socket joint
3. Pivot joint and
4. Gliding joint.

Hinge Joint

The hinge joints can be seen at the elbow, knee and between the phalanges. In the case of the elbow joint, the olecranon process of the ulna articulates with the lower end of the humerus. In the knee joint the lower end of the femur moves over the upper surface of the tibia. In the knee extra ligaments in the nature of

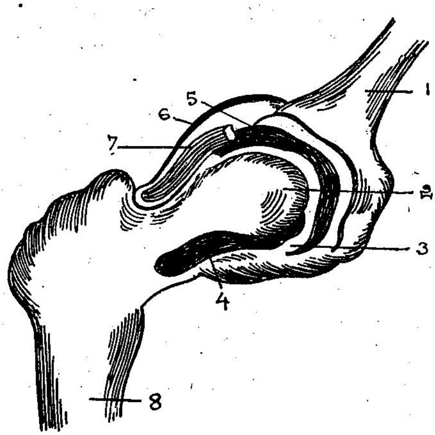


Fig. 15

Ball and Socket Joint

1. Tibia
2. Head of the femur
3. Articular cartilage
4. Synovial membrane
5. Joint cavity
6. Filuous capsule
7. Ligament
8. Femur

crucial ligaments are provided for strength. The ends of the bones are attached to each other by a strong ligament, which is called the capsule. The joint cavity is lined by a thin synovial membrane which secretes a slimy fluid to provide lubrication to the joint.

Ball and Socket Joint

In the 'Ball and Socket Joint' one end of the articulating bone is modified into a rounded shape forming as it were a ball which fits into a cavity or socket formed by the other bone. The features of a Ball and Socket Joint is that it allows movement in all directions. The hip joint and the shoulder joint belong to this group. In the hip joint, the upper end of the femur is shaped like a ball which falls into the acetabular cavity of the ilium which acts as the socket. The glenoid cavity of the scapula is the shallow socket in the shoulder joint, where the head of the humerus is the ball.

Pivot Joint

The pivot joint is seen between the Atlas and the Axis of the cervical vertebrae. The Atlas rests over the Axis with the additional process of the Axis projecting through the arch of the Atlas. In this type of joint, only rotation is possible.

Gliding Joint

The category of gliding joints which are limited in scope, are between the flat surfaces of two bones. The movements of the carpal bones when the hand is moved and the activities of the tarsals when the leg is moved and the activities of the tarsals when the leg is shifted in position are examples of gliding movements.

NERVOUS SYSTEM

The nervous system is the most important organisation which controls and integrates the different bodily functions. This system is necessary for the reception, storage and release of different informations for regulating or initiating a particular behaviour of the individual. This system can be divided into the central

nervous system, the peripheral nervous system and the autonomous nervous system. The central nervous system includes brain and the spinal cord. Peripheral nervous system consists of cranial and spinal nerves. Autonomous nervous system consists of sympathetic and parasympathetic nerves.

Histology

Nervous system is composed of nervous tissue. The nervous tissue consists of two elements : (1) the nerve cell or neuron (2) the neuroglia.

Neurone

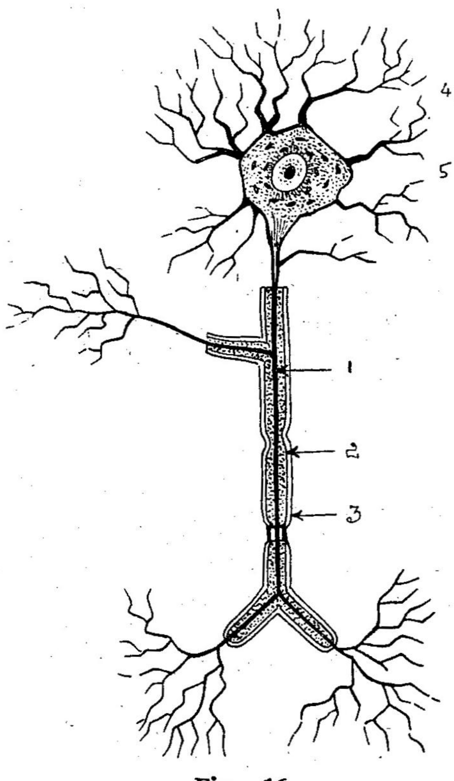


Fig. 16

Neurone

1. Axon 2. Myelin Sheath 3. Neurolemma
4. Dendron 5. Nucleus

Neurons are the structural and the functional unit of the nervous system. A nerve cell with all its processes is called a neuron. The processes are collectively called the nerve fibres. They are of two types: (1) axon or axis cylinder (2) dendron.

Axon

It is the efferent process. It carries impulses away from the nerve cell. It arises from the axon hillock. It contains no Nissil granules. It is covered by one membrane called medullary sheath.

Dendron

It is the afferent process. It collects impulses from other neurons and carries them towards the nerve cell. It is generally short with many branches, contains Nissil granules.

Cell Body

It is called the neurocyton. Neurons are commonly classified according to the number of their processes: (a) Apolar having no process (b) Unipolar having only one process—the axon, and (c) Bipolar. These are spindle shaped cells possessing the axon at one pole and a dendrite at the other.

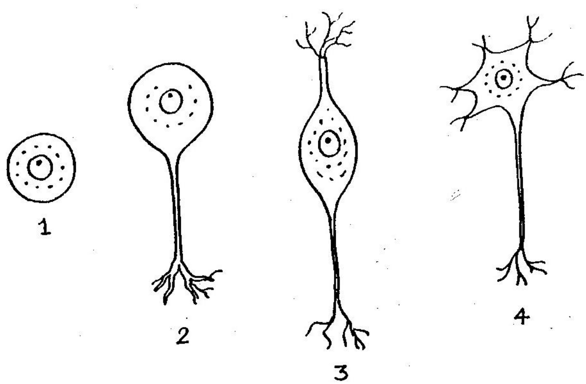


Fig. 17

Types of Neurons

1. Apolar 2. Unipolar
3. Bipolar 4. Multipolar

Neuroglia

In between the nerve cells certain other cells are also present. Based on their shape and size they are classified into three types: (1) Astrocyte (star-shaped) (2) Oligo dendroglia or Oligo dendeocyte (cells with few processes) and (3) Microglia (small in size). The first two are ectodermal in origin. But microglia is mesodermal and belong to the Reticulo endothelial system.

Functions : (1) Support (2) phagocytosis (3) Oilgodendrocyte are believed to participate in the formation of myelin sheath.

Central Nervous System

The CNS is symmetrically arranged into two lateral halves· It consists of spinal cord inside the vertebral column and brain inside the skull. The foramen magnum is the limiting membrane.

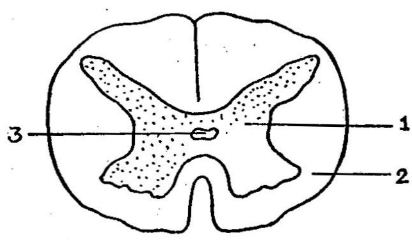


Fig. 18

Spinal cord (Section)

1. Grey matter 2. White matter 3. Epenalyma

The spinal cord consists of 31 segments. The cord is shorter than the vertebral column. The space in between the two contains cerebrospinal fluid. From spinal cord 31 pairs of spinal nerves arise. Histologically spinal cord is composed of two parts, inner grey matter and outer white matter. Grey matter is composed of nerve cells whereas white matter is composed of only nerve fibers. Neuroglia cells are present in between the nerve cells and the nerve fibres.

Functions of the Spinal Cord

Spinal cord is responsible for reflex activities. It also acts as the pathway for ascending or sensory and descending or motor tracts. A tract may be defined as the group of fibers carrying sensory impulses or motor impulses in the central nervous system.

The Brain

Brain consists of the following parts :

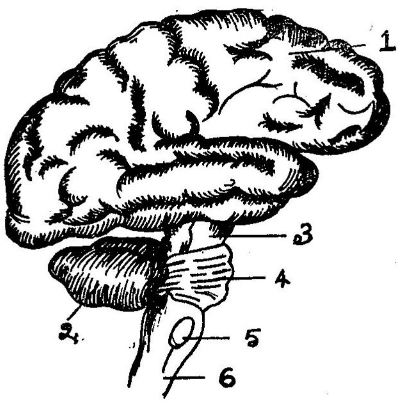


Fig. 19

Brain

1. Cerebrum 2. Cerebellum
3. Mid Brain 4. Pons
5. Medulla Oblongata
6. Spinal cord

1. Cerebrum

This is the largest part of the brain. It is divided into two lateral halves by corpus callosum. Each half is again divided into four lobes by three fissures. The lobes are frontal (anterior), parietal (middle top), occipital (posterior) and temporal (below parietel). The three fissures are: (1) central sulcus found between parietal and frontal (2) parieto-occipital found between parietal and occipital and (3) sylvian fissure between parietal and temporal.

Frontal Lobe

This is relatively much larger in the human being than in any organism. This contains the motor cortex which controls the voluntary muscles. The left side of the brain governs the right side of the body and the right side of the brain governs the left side of the body.

Parietal Lobe

This occupies the upper part of each hemisphere just behind the central fissure. This contains the sensory area in which the general senses such as pain and temperature are interpreted.

Temporal Lobe

This is lateral and folds under the hemispheres on each side. This contains the auditory center for interpreting impulses from the ear.

Occipital Lobe

This is the most posterior and extends over the cerebellum. This contains the visual area for interpreting messages from the retina of the eye.

Functions of Cerebrum

(1) Cerebrum is responsible for voluntary movement, regulation of tone, posture and equilibrium. (2) It is the chief seat of conditioned reflexes. (3) It also acts as the center for general sensations such as pain, touch, temperature and also special sensations such as taste, smell, vision and hearing. It is responsible for all intellectual functions viz. memory, intelligence, planning, judgement etc.

2. Thalamus

This is a collection of nerve cells at the top of the midbrain just below the cerebral cortex.

Functions : The thalamus is the main sensory relay station of the brain. It is the centre for crude sensation. In lower animals where cerebrum is absent, thalamus acts as the highest sensory centre. The emotional reactions are mediated through the thalamus.

3. Hypothalamus

Found just under the thalamus and forming a part of the wall and floor of the 3rd ventricle. It has got close connections

with the hypophysis. It consists of anterior group, middle group and posterior group nuclear masses.

Functions: (1) It is the highest centre for autonomic nervous system. Stimulation of posterior nuclei of hypothalamus causes sympathetic activity. Stimulation of middle nuclei of hypothalamus cause parasympathetic activity.

(2) Takes part in the regulation of body temperature.

(3) Important reflex centre for emotional expression. Stimulation of anterior group of nuclei in the case of dog produces erection of hairs, dilation of pupils, growling, lashing of the tail, sweating etc. (anger reaction).

(4) It is concerned with personality of the subject. Lesions causes changes of personality and psychic disturbances. Feeding, thirst and sleep centres are also found in the hypothalamus.

4. Brain Stem

Brain stem includes the Midbrain, Pons and Medulla Oblongata

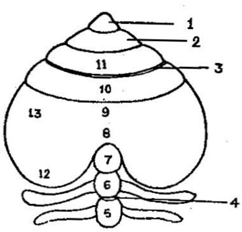
(a) **Midbrain** : Midbrain connects the forebrain with the hindbrain. This midbrain contains important correlation centres and also nuclei concerned with motor co-ordination.

(b) **Pons:** It is a thickening located above the medulla oblongata. Pons is primarily concerned with the maintenance of normal rhythm of respiration.

(c) **Medulla Oblongata:** It is the upward continuation of the spinal cord. It is approximately 28 mm. in length. It contains the fourth ventricle. Grey matter remains inside composed of various centres or nuclei. Among these respiratory centre, cardiac centre, nasomotor centre are very important. The last four cranal nerves arise from the medulla. It also carries both ascending and descending fibres.

5. Cerebellum:

It is the largest part of the hind brain and lies behind the pons and medulla oblongata. Average weight is 150 gm. In general form, the cerebellum consists of right and left cerebellar hemispheres joined by vermis. Anatomically cerebellum is divided into anterior lobe, middle lobe and posterior lobe. The anterior lobe is separated from the middle lobe by primary fissure. Middle lobe is seperated from the posterior lobe by postero-lateral fissure. Anterior lobe consists of lingula, central lobule and culmen. Middle lobe is composed of declive, folium vermis, tuber vermis, lobulus simplex, pyramid, uvula and biventral lobules.



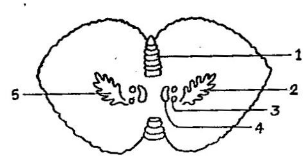


Fig. 20 **Fig. 21**

Cerebellar Hemisphere

1. Lingula 2. Central lobule
3. Primary Fissure
4. Posterio lateral fissure
5 Nodula 6 Uvula
7. Pyramid 8. Tuber
9. Declive
10. Lobulus Simplex
11. Culmen 12. L. Paramedian
13. Lobulus Arsiformie

1. Vermis
2. N. globo.us
3 N. emboliformis
4. N. fastigri
5. N. Dentatus

Posterior lobe consists of flocculus and nodules. Functionally it is divided into Archicerebellum, Palaeocerebellum and Neocerebellum. Archicerebellum includes anatomical posterior lobe and lingula, pyramid and uvula. Neocerebellum is the largest and include the whole of the posterior lobe with the exception of the pyramid and uvola. Four pairs of nuclei are found in the

cerebellum. They are nucleus fastigi, nucleus globosus, necleus emboliformis and nucleus dentatus.

Functions: Archicerebellum—It is connected with vestibular nuclei and plays an important role in regulation of posture and equilibrium. Palaeocerebellum—The anterior lobe helps in the maintenance of nucletone and synergic movements, necessary for the regulation of posture. Uvula and pyramid probably help in the regulation of equilibrium. Neocerebellum—It helps with integration and co-ordination of muscular movements.

The brain and spinal cord remain covered by three membranes (Meninges) which form outside inwards are known as dura mater, arachnoid mater and pia mater. Under the arachnoid there is subarachnoid space containing cerebrospinal fluid. The interior of the nervous system is hollowed out by four cavities (ventricles) filled up with cerebrospinal fluid. One cavity is present in each cerebral hemisphere called the lateral ventricle. They open into a common central cavity—the third ventricle through an opening on each side of the foramena. The third ventricle is continued down through the midbrain as a cerebral aqueduct. The aqueduct opens into another dilation in the medulla the fourth ventricle, which again continued downwards as the central canal of the spinal cord. The roof of the fourth ventricle has three perforations—the central one is called Foramen of Magendie and two lateral foramena of Luschka. Through these foramena, the cere-

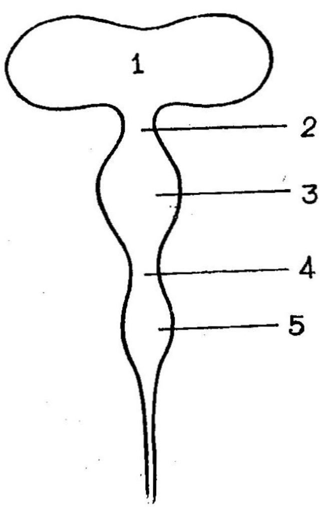


Fig. 22
Ventricles of the Brain

1. Lateral Ventricle
2. Foramen of Monro
3. Third Ventricle
4. Aqueduct
5. Fourth Ventricle

brospinal fluid enters the subarachnoid space. Thus the cerebrospinal fluid surrounds the whole central nervous system both inside and outside it. The ventricles and canals are lined by ciliated cubical epithelium called the ependyma. The movement of the cilia helps the circulation of the cerebro-spinal fluid.

Peripheral Nervous System

Peripheral nerves are (1) cranial nerves (2) spinal nerves.

Cranial Nerves:— There are 12 pairs of cranial nerves emerging from the brain. They are in their order of origin as follows :

1. Olfactory—carrying the sensation of smell.
2. Optic—carrying the sensation of vision from the retina.
3. Oculomotor—supplying all the extrinsic muscles of the eye ball except superior oblique and lateral rectus muscle of the eye ball.
4. Trochlear—supplying the superior oblique muscle of the eye-ball.
5. Trigeminal—This is a big nerve which splits into three important branches, the ophthalmic, maxikay and the mandibulen serving the sensations of the corresponding areas of the face.
6. Abducens—supplies the lateral rectus muscle of the eye ball.
7. Facial—gives motor supply to the muscles of expression.
8. Auditory—conveys the sensation of audition and the sense of equilibrium.
9. Glossopharyngeal—carries taste fibres from the posterioı part of the tongue.

10. Vagus—is the largest cranial nerve. It supplies most of the organs in the thoracic and abdominal cavities.

11. Accessory—supplies muscles of the neck.

12. Hypoglossal-is the motor nerve to the muscle of the tongue.

Spinal Nerves : There are 31 pairs of spinal nerves and each nerve is attached to the spinal cord by two roots, the 'dorsal root and the ventral root. These are mixed nerves due to contents of motor and sensor fibres. Each spinal nerve is formed by the union of anterior and posterior spinal root. Anterior root is entirely of motor fibres. Posterior spinal root consists of sensory fibres. Each spinal nerve continues only a very short distance away from the spinal cord and then branches into small posterior divisions and large anterior divisions. The larger anterior branches interlace to form networks called plexuses which then give off branches to the body parts. The three main plexuses are :

(1) The cervical plexus which supplies motor impulses to the muscles of the neck and receives sensory impulses from the neck and the back of the head. The cervical plexus, also gives off the phrenic nerve, which activates the diaphragm.

(2) The branchial plexus which sends numerous branches to the shoulder, the arm, the forearm, the wrist and the hand.

(3) The lumbo sacral plexus which supplies nerves to the lower extremities.

The Autonomic Nervous System

It is that of nervous system which controls the activity of viscera. Its actions are generally unconscious and independent of will. Hypothalamus, thalamus, cerebrum control this system. This system can be classified in three ways. According to the nature of function, it is classified into sympathetic and parasympathetic. These two are functionally opposite. Broadly speaking

functions of sympathetic are catabolic while that of parasympathetic are anabolic in nature.

Anatomically it is divided into (a) cranio sacrelarises from 3, 7, 9, 10 cranial nerve nuclei and sacrel 1 and 2 spinal cord (b) Thoraco lumbar—arises from thoracic 1-12 and lumbar 1-3. Chemically Anatomic system is divided into (1) adrenergic-those producing adrenalin at the nerve endings. This includes only the post-ganglionic fibres of sympathetic except the sympathetic fibre supplying sweat gland. (2) cholinergic—produces acetylcholine at the nerve endings. This includes (i) The whole of parasympathetic both preganglionic and post ganglionic fibres (ii) all the ganglionic sympathetic fibres (iii) post ganglionic sympathetic fibre supplying the sweat-gland.

Functions of sympathetic and parasympathetic systems

The sympathetic and parasympathetic system, by acting oppositely take part in maintaining the body temperature mechanism in response to change in external or internal environments. The sympathetic system directs to strengthen the subjects ability to adopt itself following a change in its internal environment, such as fall in heart rate, blood sugar, blood pressure etc; and in external environment for securing foods and protection, whereas the parasympathetic system is concerned with restoring and conserving energy.

Reflex action

Brain is like a very fine electrode computer receiving information from various sources, collecting and analysing it, and giving appropriate stimuli for action. There are a large number of actions, which do not require the intervention of the brain and can be executed at lower levels. Of course, there are classical examples of the heart beat, respiratory movements and gastric secretion which are done automatically without conscious effort. These are controlled by the autonomous nervous system. Apart from this there is a large group of activity, many of them voluntary in nature which are also done similarly. The closing of the eyelid when light falls on it, removing the hand when it touches some-

thing hot, locking a knee joint to support the body when the other joint relaxes, coughing when the throat is irritated are all examples of reflex activity. Indeed most of the voluntary activity that we do are reflex in nature and reflex action can be considered as the most elementary type of nervous activity.

Let us take the example of the knee jerk. When the patellar tendon is tapped by a knee-hammer there is a sudden unconscious tensing of the thigh muscles resulting in an upward movement of the leg. Thus the minimum criteria required for reflex activity are the following : There should be stimulus and a receptor which

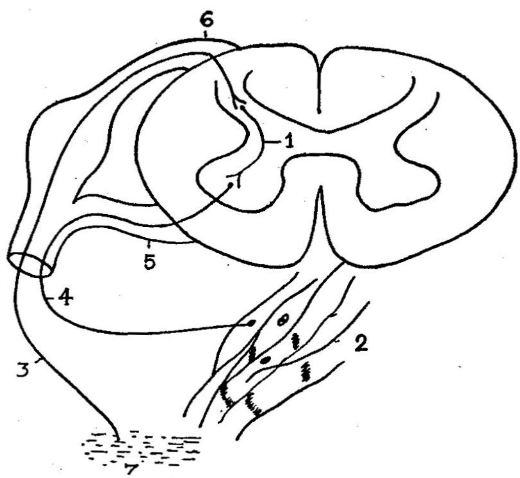


Fig. 23

Reflex Arc

1. Centre 2. Muscle 3. af. nerve
4. ef. nerve 5. Ventral root 6. Dorsal root
7. Skin

responds to the stimulus. The stimulus must be carried by a sensory nerve called the afferent arc. There should also be a centre reacting to the stimulus, which in this case is situated in the spinal cord. The motor impulse is carried in the peripheral direction by the efferent limb of the arc. There should be an

effector organ capable of reacting to this stimulus, which in this particular instance is the muscle of the thigh.

Reflex action possesses a large number of special characterisics depending on the synapses between the nervous existing on an individual case. A sensory stimulus in a specific spot always produces a definite localization of motor reaction. More over two sensory stimuli can be summated both in space and time. Facilitation is the property by which a second impulse produces a better reaction than a previous one. Another property of reflex action which is very useful for co-ordinated muscular activity is reciprocal innervation. Contraction of the flexor muscles produces purposeful muscular activity if it is associated with the relaxation of the contralateral extensor muscle or facilitation in one direction must co-exist with inhibition of all opposite reflexes. Thus in all reflex activity one particular pathway must be prepotent. This is achieved by inhibition of all opposing activity and facilitation of the useful reflex arc which is due to reciprocal innervation. The reflexes are poorly developed in children and it can be developed and controlled by will power and training.

Conditioned reflex

There is another type of reflex which is developed only with experience. A new born child will not secrete saliva if food is shown or if it smells food. On the other hand, an adult will salivate on the sight or smell of food because of the association of these special senses with food. These types of reflexes are called conditioned reflexes. If a specific stimulus applicable to a special sensation like the ringing of a bell or showing of light is followed by food, a conditioned reflex is built up. After a few times the ringing of the bell alone will cause salivation. This training is called a lesson and there is practically no limit to which a special sense can be employed in this manner. Moreover secondary and tertiary reflexes can be built up on primary reflex. The conditioned reflex can be inhibited or stopped by a painful stimulus from outside. This is called external inhibition.

SENSORY SYSTEM

One of the important functions of the central nervous system is the collection of information both from the outside world as well as from inside the body. There are a large number of specialized end-organs situated in the different parts of the body called receptors. The receptors are divided into general receptors which carry general sensations and special receptors which are responsible for special sensations. Special receptors are limited to a relatively small area in the body where as general receptoıs are scattered through out the body.

General sensations

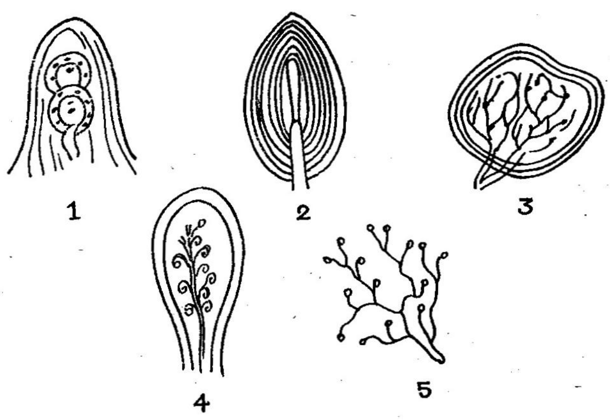


Fig. 24
Sensory Receptors

1. Messiner's corpuscle 2. Pacinian corpuscle
3. End bulb kranse 4. Organ of Golgi Mazzoni
5. Free Terminals

General sensations are touch, pain, temperature and pressure. The receptors responsible for touch are tactile corpuscles and free nerve terminals, for cold endbulb of krause, for heat organ of Golgi Mazzoni. Each receptor is sensitive to specific stimulus. The stimuli which are received in these end-organs are converted as electrical impulses which travel up through the sensory portions

of the peripheral nerves and reach the posterior horn cells of the spinal cord. From there the impulses are carried out by fasciculus gracilus, fasiculus cuniatus, ventral and later spinothalamic tract to thalamus and the crude sensations end in the thalamus itself wheres fine sensations ascend upwards and end in the cerebral cortex.

Special sensation

Special sensations are vision, hearing, smell and taste. Eye is responsible for vision, ear is responsible for hearing. Nose and Tongue are responsible for olfaction and taste respectively.

The Eye-Vision

Human eye ball is roughly spherical in shape found in the orbit. Optic nerve enters the eye ball through optic disc. No visual receptors are present in this area. Hence it is called blind spot. From outside inwards the wall has three coats (1) fibrous coat (2) vascular coat (3) nervous coat.

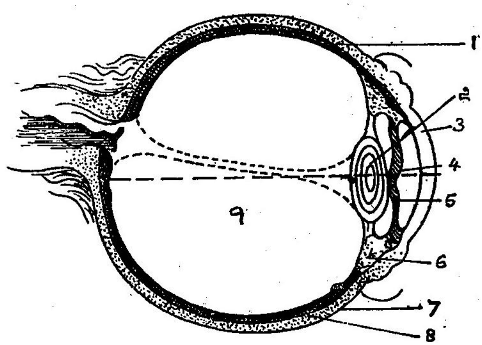


Fig. 25

Structure of the Eye

1. Retina 2. Lens 3. Cornea 4. Pupil
5. Iris 6. Ciliary Muscles 7. Sclerotic coat
8. Choroid Plexus 9. Posterior chamber

Fibrous coat is again divided into two parts (1) Posterior $\frac{5}{6}$th is opaque and called sclera (2) Anterior $\frac{1}{3}$ is transparent and called cornea. Vascular coat is composed of three parts. (a) Choroid plexus found in between the fibrous and nervous coat (b) the ciliary body (c) the iris. The pupil is the aperture surrounded by the iris. The inner most layer of the eye ball is retina. It is the light sensitive layer situated between the choroid and vitreous. This retina contains photoreceptors. These are rods and cones. Human eye ball is divided into two by a lens. This lens is attached to the eye ball by suspensory ligaments. Anterior to the lens is known as anterior chamber which contains a thin fluid—aqueous fluid. Posterior to the lens contain posterior chamber which is filled up with a fluid known as vitreous humour. These aqueous as well as the vitreous humours are transparent and allows light to pass through.

The exposed part of the eye ball is covered by a thin stratified mucous membrane which is reflected on to the inner surface of the eyelids. It is called conjunctiva. Its function is protection and lubrication. The rays of light which fall on the eye first passes through the cornea, aqueous humour, vitreous humour and finally falls on the retina. The iris is a dark screen and by its movement acts as a diaphragm to adjust the amount of light which travels through the eye. When a bright light is focussed on the eye it contracts while it dilates in poor light admitting as much light as possible. The lens is biconvex and is designed to converge the rays of light, and focus it on the retina which is the chemically sensitive film of the human eye.

Physiology of Vision

When light falls on the retina certain chemical, electrical and sensory changes result. The sensitive elements in the retina are the rods and the cones. The rods contain a purple coloured matter called visual purple. This is bleached into visual yellow. The visual purple is reformed in the darkness. Bleaching and regeneration are independent of nerves. It is held that either the bleaching process itself or some product formed during bleaching

stimulates the rod to generate the visual impulses. In other words radiant energy is converted into nerve impulse through this photo chemical process. Visual impulses arise in the rods and cones pass through optic nerve. These nerves cross each other in the optic chiasma in front of the pituitary fossa and relay in the lateral geniculate bodies. From here fresh fibres arise which end in the occipital lobe of the cerebral cortex after travelling as optic radiations. The areas 17, 18, 19 of the cortex analyse and interpret the visual sensation.

Light and dark adaptation

If the eye after being exposed to dark be rapidly exposed to strong light or vice versa, the eyes take a little time to get adopted.

Hearing — Ear

Hearing like vision is one of the sensations which we can appreciate from distance and is equally useful as vision for orientation in space and conveyance of information. Sound travels in the form of waves. It is the amplitude of these waves

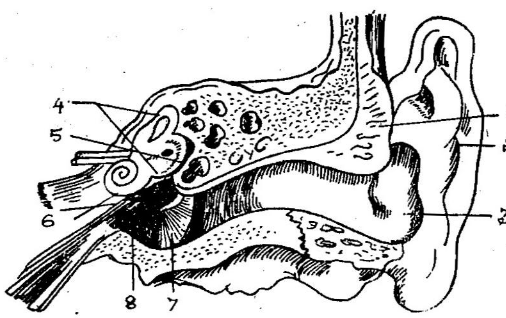


Fig. 26

Inner parts of the ear

1. Inner Ear 2. Pinna 3. Auditory canal
4. Semi circular canals 5. Hammer Bone
6. Cochlea 7. Tympanic membrane 8. Tympanic Gland

which denotes loudness, while the wave length determines the pitch. The sound waves enter through the pinna or external ear which serves as the horn of a megaphone. In lower animals the pinna

can be removed and sound waves can be caught. Man has lost this ability due to evolutionary rise. The sound waves pass through the external auditory meatus which is directed medially and upwards. The inner end of the meatus is covered by the tympanic membrane

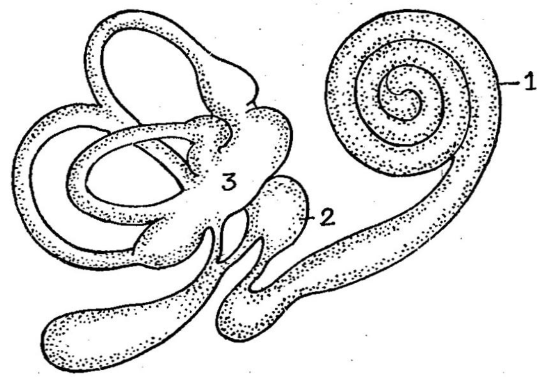


Fig. 27
Schematic diagram of internal ear
1. Cochlear 2. Saccule 3. Utricle

which vibrates in unison with the sound waves falling on it. The sound waves are carried through the middle ear into the cochlea or inner ear through a chain of very small bones called the ossicles. The three ossicles are named after their shapes, that is the malleus or the hammer, the incus which is like an anvil and the stapes or stirrup. The ossicles convert the periodic vibrations of the tympanic membrane into periodic ones and give them a direction. The middle ear cavity communicates with the pharynx by the pharyngo-tympanic tube which helps the regulation of the pressure inside the cavity.

The Cochlea consists of a tunnel which takes two and a half turns round a centrally placed bone called the modiolus. The tunnel is further sub-divided into three concentric passages by means of two membranes called thebasilar membrane and Reissners membrane. The whole cavity is filled with endolymph and the sound vibrations falling on the middle wall causes ripples in the fluid. Certain specialized cells are present on the basilar membrane

and these cells are the essential end-organs of hearing. The cells have small hairs projecting from their surface and the pull or wavy motion of these hairs are the stimuli for the sense of hearing. The basilar membrane has smaller strings or fibres at the base and the longer ones at the apex. Depending on the pitch different regions vibrate and it is the place of vibration which determines the appreciation of the pitch. The stimulus is carried upto the brain by the cochlear portion of the VIII nerve or auditory nerve and forms the lateral leminiscus and ends in the medial geniculate body. Because the medial and lateral geniculate bodies are near each other visual and auditory radiations can be co-ordinated. The auditory radiations ultimately end in the temporal lobe, which is the highest centre for hearing.

Olfaction

The olfactory sense is a true chemical sense. Unless the molecule of the odoriferous substance get dissolved in the secretions of the nasal mucous membrane and comes into intimate physical contact with olfactory cells, it is not possible for anybody to appreciate the sense of smell. This is the cause of the loss of the sensation of smell in common cold (where there are no secretions).

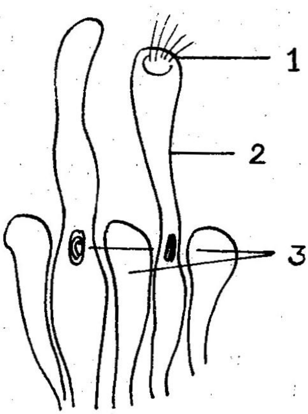


Fig.28

Olfactory Epithelium

1. Hairs 2. Bipolar cell
3. Supporting cell

The olfactory eipthelium lies in the upper most part of the nasal-cavity and differs from the respiratory epithelium in its appearance. It is brownish in colour and consists of bi-polar nerve cells, with supporting columnar cells and basal cells. The bi-polar nerve cells are the essential end-organ cells and their axons end in the olfactory vesicle. From here they proceed through the cribriform plate of the ethmoid bone to end in olfactory glomerni.

The olfactory tract which starts from there goes to the

centre for smell. The sense of smell is closely associated with that of taste so that it has been nicknamed as "taste at a distance". Actually what is meant by the term flavour is the combined effect of taste and smell.

Loss of sense of smell is known as Anosmia. Hyperosmia is the morbid sensitiveness to odours. It occurs in hysteria, in raised pressure etc.

Taste

Taste is also another chemical sense. Tongue is mainly concerned with taste sensation. Taste buds are the end organs of taste. There are mainly four taste sensations such as sweet, salt, sour and bitter. Sweet and salt are chiefly at the tip, sour at the sides and bitter at the back of the tongue.

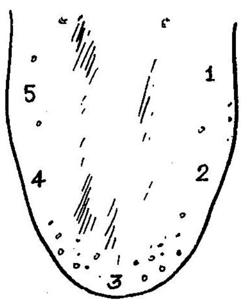


Fig. 29

Tongue

1, 5. Sour 2, 4-Salt
3. Sweet

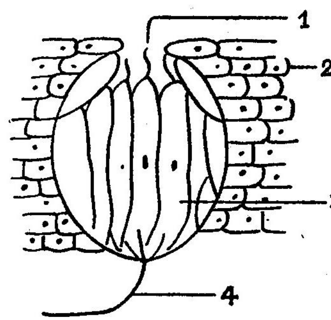


Fig. 30

Taste Buds

1. Gustatore Pore 2. Supporting Cell
3. Neroepithelial cell 4. Nerve

Taste buds

Taste buds are oval about 70 μ long and 50 μ broad. Vessels and nerves enter through the bottom. Taste bud is made up of two types of cells (a) neuro epithelial cell or taste cells. These

are fusiform in shape and contain hairs; (b) supporting cells found in between the taste cells.

The substance to be tested must be in solution. Normally saliva acts as the solvent. It has been calculated there are about 9000 taste buds in man. The sensation of taste is carried mainly by the chordae, tympani branch of the facial nerve and the glosso-pharanyngeal nerve and ends in the inferior part of the post-central gyrus of the cerebral cortex.

CHAPTER II

Foods and Nutrition

NUTRIENTS

Nutrition and Health

Man can live in happiness without many earthly possessions but not without good health. Health means complete physical, mental and social well being which enables a person to live most and serve best. Good nutrition is necessary for good health. The body is the product of its nutrition. What is nutrition? It has been defined in many ways. Nutrition is the combination of processes by which the living organism receives and utilises the materials necessary for the maintenance of its functions and for the growth and renewal of its components.

In the promotion and maintenance of health, the food we eat, the way in which it is cooked and consumed and the various factors which establish food habits and constitute the nutritional status have a vital part to play.

There must be adequate food for all the people both in quantity and quality. Malnutrition arising out of deficiencies in both food and nutrients is the cause of many diseases that are rampant in our country. Malnutrition adversely affects mental and physical development of children. This prevents the chances of their becoming readers and writers. Malnourished children cannot concentrate on their studies. Early childhood nutritional deficiency makes the victim incapaciated for future life. Malnutrition affects national productivity by placing limits on individual productivity.

Therefore, knowledge of nutrition and its relation to health is necessary for good living.

What Foods Contain

The foods that we eat contain nourishing substances called nutrients. They are — carbohydrates, proteins, fats, vitamins and

minerals. Most foodstuffs contain more or less all the nutrients but in varying proportions. Some foods like cereals, roots and tubers like potato and yam, oil seeds and sugar and jaggery give more energy than the others. Foods like dhal contain protein. Milk contains several nutrients. What exactly are these nutrients? Carbohydrates, proteins and fats are needed in large amounts and all of them supply energy to keep the body going. Vitamins and minerals are required in very small amounts to regulate body functions.

Energy

The human body is an engine, which can set free the chemicals energy in fuels present in foods. These are carbohydrates, fats and proteins. Since the body continually converts and replaces its component parts energy is needed for the synthesis of new organic substances in this continuing process of maintenance. The body also has to have energy for physical growth and internal work, such as the action of the heart in circulating the blood and the movements of the diaphragm in breathing. Additional fuel is needed for external work performed by the muscles such as moving the body about, maintaining its posture, lifting and carrying loads, and the varied physical activities of everyday life.

It is customary to express the energy content of foods and the energy requirements of man and animals in terms of kilocalories. A kilocalorie (kcal) is defined as the amount of heat required to raise the temperature of a litre of water from 15 °C to 16° C. The new term for quantitatively expressing energy is Joule. One kilocalorie is equal to 4.134 kilojoules (kj)

The approximate energy value of the body fuels are the following: for carbohydrate, 4 kcal or 16.7 kj per gram; for fat, 9 kcal or 37.7 kj per gram; for protein, 4 kcal or 16.7 kj per gram. These are not values.

Energy Requirements of Adults

The energy requirements of persons of different occupation, age, and size can be considered by reference to a man

and woman 25 years of age and weighing 55 kg and 45 kg respectively. Assuming that one spends eight hours each in bed, at work and in non-occupational activities, the total energy expenditure of men and women can be calculated.

The energy expended during the eight hours at work is thus determined by occupation and affected only to a small degree by the individual. A rough classification of the different occupations by level of activity is given below.

Light (Sedentary)

Men: Office workers, lawyers, doctors, teachers, architects.

Women: Housewives, teachers and professional.

Moderately active

Men: Most men in light industry, students, farm workers, soldiers, fishermen.

Women: Industrial workers, housewives, students and shopkeepers.

Very active (Heavy work)

Men: Some agricultural workers, forestry workers, mine workers, steel workers and athletes.

Women: Some farm workers, dancers, athletes.

Exceptionally active

Lumberjacks, blacksmiths, rickshaw pullers.

The energy expenditure per hour by men and women for light work is 140 and 100 Kcal respectively; for moderately active work, 175 and 125 kcal and for very active work, 240 and 175 kcal and for exceptionally active work 300 and 225 kcal.

In addition to physical activity and to the type and nature of non-occupational activities, the energy requirements of indivi-

duals vary chiefly according to (a) body size and composition and (b) age.

Body size and composition

Energy expenditure may be influenced by the effect of body size and composition on (a) resting metabolism (b) the physical activity (c) the physical efforts and the quantity of adipose tissue in his body.

Age

The energy expenditure of adults may alter with age because of (a) changes in body weight (b) a decrease in the basal metabolic rate (c) a decline in physical activity and (d) an increasing prevalence of disease and disabilities.

Calorie inadequacy

Underweight results when the energy intake does not fully meet the energy requirements. This occurs commonly in people who are very nervous and who get little rest. Irregular eating and poor selection of foods are responsible for an inadequate calorie intake. In underweight individual, the resistance to disease is lowered, growth during childhood retarded, efficiency is impaired, fatigue sets in easily.

Energy requirements

Infants : The energy requirements of infants during the first six months of life can be estimated from the observed intakes of breast fed infants who are growing normally.

Children and adolescents: Recommendations for the energy requirements of children are based mainly on measurements of the actual food intakes of healthy children who are growing normally.

During adolescence both girls and boys grow at a faster rate than at any other time except in infancy.

Pregnancy and Lactation: During pregnancy extra energy is needed for the growth of the foetus as well as the placenta and associated maternal tissues, and for the increased cost of movement for the heavier mother. Since a reserve energy of 36,000 kcal deposited as fat during pregnancy is available for lactation, the additional energy requirement for lactation will be 550 kcal per day.

Selection of food for energy

More foods from the cereal group will not only increase the caloric intake but will enhance protein, iron and B complex level of the diet. Fats and sugars are concentrated sources of energy and may be used to rapidly increase the caloric level of the diet. Fats and sugars do not contain protein minerals and vitamins. When they constitute a large proportion of the total calories in the diet there is a danger of other nutrients not being met.

CARBOHYDRATES

Carbohydrates are simple sugars or substances that can be reduced to simple sugars by hydrolysis. They are made up of carbon, hydrogen and oxygen, the last two being in the proportion to form water—hence the term carbohydrate.

Classification of Carbohydrates

The carbohydrates in food may be classified into three groups as given below :

I. Monosaccharides

These are simple sugars and are the smallest of the carbohydrate molecule. They cannot be split further. They are easily soluble in water. The three important monosaccharides or single sugars are glucose, fructose and galactose.

Glucose: Glucose is sometimes called dextrose group sugar or corn sugar. This is the only sugar known to exist in the free state in the fasting human body. Glucose is a reducing

agent. It can reduce alkaline copper compounds. Few natural foods except some fruits such as grapes contain more than traces of free glucose.

Fructose: Fructose is also known as levulose or fruit sugar. It is found in free form in some fruits and also in honey. Fructose is sweetest of all sugars.

Galactose: Galactose results from the hydrolysis of lactose or milk sugar. It does not occur in the free state in nature.

II. Disaccharides

Disaccharides or double sugars are formed when two monosaccharides unite or condense together with the elimination of one molecule of water. They are split to simple sugars by hydrolysis and by digestive enzymes. The three important sugars in this group are:

Sucrose: Sucrose the table sugar is found in sugarcane, sugar beets, sorghum cane and in many fruits and vegetables. Sucrose on hydrolysis yields glucose and fructose.

Maltose: Maltose or malt sugar is found in malted products such as cereals and beer. It is formed from the breakdown of starch in malting of barley. Maltose on hydrolysis yields two molecules of glucose.

Lactose: Lactose or milk sugar is produced only by mammals. It is derived from two monosaccharides linked together, one of which is glucose and the other galactose. It is not very soluble and is much less sweet than the other single or double sugars.

III. Polysaccharides

Polysacharides are complex compounds. They are not as crystalline as mono and disaccharides. They are generally insoluble. As the name indicates, these are formed by the condensation of many monosaccharide units with the elimination of water.

Starch: Starch is the form in which plants store carbohydrate and this is the primary source of energy in the diet. Cereal grains, seeds, roots, potatoes, green bananas and other plants contain considerable starch. It is insoluble in cold water but in boiling water the cell walls are ruptured, the starch abosorbs water and thickening results. The starch molecule can be broken down by heat, enzymes or acids to intermediate products called dextrins and finally to glucose.

Cellulose: Cellulose is the fibre on which green plants depend for support. It is present in wood, stalks, leaves, skins of fruits, the coverings of seeds and bran of grains. Cellulose like starch is made entirely of glucose. It does not disperse in water and is resistant to hydrolysis by acids and enzymes in the human gut.

Hemicellulose: Hemicellulose belong to the walls of plant cells. On hydrolysis they yield monosaccharides or mixtures of monosaccharides and disaccharides. Man has no ability to digest hemicellulose. It contributes to roughage that passes undigested.

Glycogen: Glycogen is the animal equivalent of starch and is found in human tissues. Liver is the principal store house of glycogen. Excess sugar in the body is converted into glycogen and stored in liver or muscles. Glycogen can be broken down to glucose later to yield energy.

Functions

Carbohydrates supply potential energy. Each gram of carbohydrate yields four calories. Dietary carbohydrate has a protein sparing action. The body will use carbohydrate as a source of energy if it is adequately supplied, sparing the protein for synthetic purposes. A certain amount of carbohydrate is necessary in the diet so that the oxidation of fats can proceed normally.

Digestion and absorption

Most of the digestive action on carbohydrates takes place in the small intestine. Simple sugars are ready to pass through

the absorbing walls of the digestive tract as soon as they reach the small intestine. The double sugars are carried one step in digestion to become simple sugars. Starches are broken down finally to glucose. The simple sugars are carried by blood stream to liver and to the tissues. There is no chemical change in fibre in the human digestive tract. Fibres are broken down and excreted.

Daily allowance

The Indian Council of Medical Research makes no exact recommendation for carbohydrate. At least 50-60 per cent of the dietary calories can come from carbohydrates.

PROTEINS

Proteins are indispensable constituents of living protoplasm and as such participate in all vital processes. Proteins are large molecules made up of nitrogen containing amino acids that are linked together by a peptide linkage. Some amino acids are not essential as they are synthesized by the body. Whereas some are indispensible or essential they must be supplied by the diet.

Functions

1. Proteins are essential for growth.

2. The body is constantly undergoing wear and tear which is repaired by proteins.

3. Proteins supply raw materials for the formation of digestive juices, hormones, plasma, proteins, haemoglobin, vitamins and enzymes.

4. One gram of protein supplies four kilocalories of energy.

5. Proteins function as buffer, thus helping to maintain the reactions of various media.

Classification

Proteins can be classified as either animal proteins or vegetable proteins. Animal proteins contain more of the essential amino acids than vegetable proteins and in general have a higher nutritive value. More recent knowledge of the biological differences among amino acids has lead to the classification of proteins as biologically complete or as biologically incomplete.

Complete protein

A biologically complete protein is one which contains all of the essential amino acids in adequate amounts to meet human requirements.

Incomplete protein

A biologically incomplete protein is deficient in one or more of the essential amino acids. This deficiency may be either absolute or relative. Most of the vegetable proteins lack one or more of the essential amino acids and are thus classified as biologically incomplete proteins although mixtures of vegetable proteins may present all the amino acids in adequate quantities.

Digestion and absorption

After ingestion, dietary proteins are acted upon by proteolytic enzymes like pepsin, trypsin and chymotrypsin and converted into amino acids, which are absorbed and used for tissue synthesis or the formation of enzymes, certain hormones and other proteins of special significance.

Requirements

All estimates of protein requirements are valid only if energy requirements are fully met. If not there is a possibility for the protein to be utilised for energy purposes. Soyabean, groundnuts, pulses, oilseeds and nuts also provide protein. Recently proteins from leaf have been processed and efforts are being made to popularise them.

Deficiency

A reduced protein intake over an extended period of time leads eventually to depletion of the labile tissue reserves and then to lowering of blood protein levels. The speed with which the deficiency develops depends upon the quality and quantity of the protein intake, the calorie intake, the age of the individual and other factors.

Kwashiorkor is a public health problem occuring in infants of underdeveloped countries. It occurs mostly in infants after weaning when the diet which replaces the mother's milk is markedly deficient in protein but high in carbohydrate especially starch. Kwashiorkor has its highest incidence between the ages of one and four years when the need for essenetial amino acids for tissue synthesis are great. The classic symptoms include growth failure, retarded development, loss of appetite, mental apathy, oedema, diarrhoea, pellagra, skin lesions and colour and texture changes of the hair. There may be various vitamin deficiencies. Anaemia is frequent and is aggravated by worm infestations.

In protein deficiency in adults, blood proteins are lowered and loss of weight occurs. Oedema, anemia, liver troubles, deceased resistance to infections and reduced muscle tone follow. Infections and infestations affect protein requirements during infancy. Need for protein in childhood and adolescence are greater than those of adults due to the growth.

When breastfed by a healthy well nourished mother with normal lactation, the new born child consumes adequate amount and quality of dietary protein to meet this protein requirements. After the age of five when the growth rate slows down a child thrives on a normal diet with adequate protein.

The nutrition of the pregnant woman has an important influence on the course of pregnancy and the health of the infant. The pregnant woman requires an additional allowance of good quality protein such as that of milk or egg to cover the extra needs.

The additional protein needed by the lactating woman can be estimated from the volume and composition of the milk secreted. During the first six months the average volume of milk secreted is 850 ml per day. As human milk contains an average of 1.2 grams of protein per 100 millilitres, the protein content of the daily secretion is about 10 grams. An additional allowance of 17 grams of good quality protein of the same covers the extra needs.

Sources

Cereals supply the largest amount of proteins in the diet in under developed areas. Animal foods provide proteins of high biological value.

FATS

Fats are made up of essential and non-essential fatty acids and glycerol. They are the most concentrated form of all energy-giving foods.

Functions

(1) Fat supplies 9 kcalories per gram. (2) Vegetable fats provide essential fatty acids such as linoilec and arachidonic acids, (3) Being concentrated fuels, fats reduce the total bulk of food in the meals. They lend staying power to food and add satiety value because they are digested and absorbed slowly and therefore remain in the stomach for a longer period. 4 They are stored in the body to be used as reserve in times of need and emergency, such as starvation and sickness. (5) Fats act as a padding material and give protection against injuries to the vital organs such as liver, heart etc. (6) As an insulating material fats guard the body against cold and heat. (7) Fats give roundness, beauty, shape and contour to the body. (8) Fats are solvents for vitamins A,D, E and K. (9) They add to the taste, texture and flavour of food.

Deficiency

Like vitamins, the essential fatty acids also play a role in several metabolic reactions and a deficiency of these acids in the

diet leads to a skin condition known as phrynoderma in which skin becomes rough, and thick, horny papuls of the size of a pin-head erupt in certain areas of the body, notably thigh, buttocks, arms and trunks.

Requirements

The quantity of fat that should be included in a well-balanced diet is not known with any degree of certainty. But a total of about 40-60 g. of fat can therefore be consumed daily which should include 15 g. of vegetable oils.

Sources

Vegetable oils, oil-seeds, nuts, butter, ghee and fatty meat provide fats.

MINERALS

By the term minerals we mean the elements in their simple 'inorganic form'. In nutrition they are commonly referred to as mineral elements or inorganic nutrients. There are many mineral elements. Approximately 17 have been proved essential in nutrition. The essential minerals have been classified as macro nutrient elements and the minerals of the body include calcium, phosphorous, potassium, sulphur, sodium, chlorine, magnesium, iron, zinc, selenium, manganese, copper, iodine, molybdenum, cobalt, chromium, fluorine and traces of other minerals. They exist in the body and food in organic and inorganic combinations. Only four per cent of man's weight is in the form of minerals.

Functions

Mineral elements have many essential roles both in their ionic forms in solution in body fluids and as constituents of essential compounds. The balance of mineral ions in body fluids regulates the metabolism of many enzymes, maintains acid base balance and osmotic pressure, facilitates membrane to transfer essential compounds, maintains nerve and muscular irritability

and in some cases as building constituents of body tissue. Indirectly many minerals are involved in the growth process; other minerals have no known functions.

Calcium

Calcium is by far the most abundant mineral element in the body about 99 per cent of it occurring in the bones and teeth. The one per cent not contained in bones and teeth is present in blood, extracellular fluids and within the cells of soft tissues where it regulates many important metabolic functions.

Functions

In addition to the major function of calcium to build and maintain bones and teeth, the remaining one per cent of the body's calcium which is found in the body fluids and soft tissues is principally in ionic form and has important metabolic functions. It is necessary for the activity of certain enzymes, in release of energy for muscular contraction.

In the blood clotting process, calcium must be present. Calcium controls the permeability of the cell membrane to various nutrients. For normal nerve transmission and regulation of the heart beat calcium is required. Calium together with correct amount of sodium, potassium and magnesium maintain muscle tone and muscle irritability.

Absorption and utilization

Calcium absorption in human is very inefficient. Usually only 20 to 30 per cent of the ingested calcium is absorbed. About 70 per cent is unabsorbed and is excreted in the faeces. Most of the absorption of calcium occurs in the upper part of the small intestine.

Many factors favour calcium absorption. Vitamin D is required for efficient absorption of calcium. Calcium is made soluble by acids. The hydrochloric acid secreted in the stomach provides the acid medium which favours absorption. In the presence of

lactose absorption of the mineral is improved. Fat in moderate amounts moving slowly through the digestive tract facilitates absorption. When the intake of protein is high, the action of certain amino acids upon the formation of soluble complex with calcium facilitates calcium absorption.

There are many factors which depress the absorption of calcium. Lack of vitamin D decreases or prevents the absorption of calcium. Excessive intake of dietary fats lead to poor absorption. In an alkaline medium calcium will form insoluble compounds which cannot be absorbed. Stress and immobilization also hinder absorption and the ratio of elements. Excess of either one in the dietary causes poor absorption.

Effects of deficiency

Suboptimal intakes of calcium may result in retarded calcification of bones and teeth in the young. Such deficiency leads to stunted growth and bones become soft and fragile. Rickets develop in children as evidenced by bowing of legs, enlargement of the ankles and wrists and a hollow chest. Adult rickets or osteomalacia are seen in adults; with advancing age the bones become fragile and may break more easily. If this process is accelerated it gives rise to the disease known as osteoporosis common in old people in all countries, which may cause great pain and eventual disability.

Requirements

An adult requires 0.4 to 0.5 gram of calcium per day. The requirement is greatly increased during pregnancy and lactation. Children require adequate amounts of calcium for strong bones and growth.

Sources

Milk and cheese are the richest sources of clacium; certain green leafy vegetables like spinach, amaranth and drumstick are also rich sources. In fish, it is as low as 10 per cent. Meat and cereal grains with the exception of ragi are poor sources.

Phosphorus

Phosphorus ranks next to calcium in the total amount of mineral present in the body and constitutes about one fourth of all body minerals. About 80 per cent is in the form of insoluble calcium phosphate crystals that give strength and rigidity to bones and teeth. The remaining phosphorus is distributed in every cell in the body and in the extracellulor fluid in combination with carbohydrates, lipids, proteins and a variety of other compounds.

Function

Phosphorus has numerous functions in the body beyond its important part in the structure of bones and teeth more than any other mineral element. It occurs in nerves, nerve cells and the brain. It is necessary in the metabolism of glucose. It is a component of adenosine triphosphate which supplies energy for muscle contraction. It is also constituent of enzymes that participate in the metabolism of carbohydrates and fats. It plays an essential part in regulating the neutrality of the blood.

Absorption

Normally about 70 per cent of the phosphorus ingested in food is absorbed. Most favourable absorption takes place when calcium and phosphorus are ingested approximately in equal amounts. The factors that aid or prevent the absorption of calcium act essentially in the same manner with regard to absorption of phosphorus.

Requirements

The daily intake of phosphorus should at least equal that of calcium for all age groups except the young infant. The phosphorus allowances for young infants to one year of age are slightly less than those of calcium. Because phosphorus is widely distributed, there is little possibility of a dietary inadequacy, if the food contains adequate protein and calcium.

Sources

Meat, poultry, fish and eggs are excellent sources of phosphorus. Milk and milk products are good sources as are nuts and legumes.

Iron

Iron is present in the body in relatively small amounts (3 to 4 grams) of which more than two thirds is present in haemoglobin, the pigment of red blood cells. The rest of the iron in the body is present as a reserve store in the liver and to a lesser extent in the kidney and spleen.

Functions

Iron is one of the most important elements in nutrition and of fundamental importance to life. Iron is a component of haemoglobin, myoglobin, the cytochromes, catalase, peroxidase and certain other enzymes. It serves important functions in oxygen transport and cellular respiration.

The red blood cells and the pigment within are broken down and replaced every 120 days but the liberated iron is not excreted, as most of it is utilized to form new haemoglobin.

Absorption

Absorption of iron can take place from the stomach and throughout the whole of the small intestine; however the greatest absorption occurs in the upper part of the small intestine.

It is estimated that only 15 to 30 per cent of the iron in food is absorbed by normal adults. From 2 to 10 per cent of iron in vegetables and from 10 to 30 per cent of iron from foods of animal origin can be absorbed. Ascorbic acid, sulphydryl groups and similar reducing substances facilitate the absorption of ingested iron. Iron absorption is increased in haemoglobin synthesis—for example following haemorrhages or resulting from anemia. Absorption also increases during growth and pregnancy. Phytic acid

and excess of phosphates may impair iron absorption because of the formation of insoluble iron salts which pass through the intestinal tract without being absorbed.

Effects of deficiency

Inadequate dietary intake of iron by growing children, by adolescent girls or by women especially during pregnancy and in lactation will produce nutritional anemia, characterized by a decrease in the amount of haemoglobin and by small pale red blood cells, depleted iron stores, and a low plasma iron content. The number of red blood cells may also be reduced. Iron deficiency anemia is a medical and public health problem of primary importance causing a few deaths but contributing seriously to the weakness, ill health and substandard performance of millions of people.

Requirements

Infants are born with a small reserve of iron. In the case of infants the iron requirements should not only compensate for basal iron losses but also provide for an increase in haemoglobin mass.

In pregnant woman iron is required not only to replace basal physiological losses but also to allow for expansion of the red blood cell mass and to provide for the needs of the foetus and placenta; The net cost of pregnancy is 565 mg of iron. The iron secreted in breast milk has been estimated to be 0.25 mg per day and an additional requirement of 12 mg of iron daily will meet the demands of lactation. The increased requirements of iron during pregnancy and lactation can easily be met by the normal additional needs for menstruation. Since there is a cessation of menstruation during pregnancy and early lactation, the allowances for non-pregnant and non-lactating women of child bearing age suffice during pregnancy and lactation.

Sources

Of all nutrients, the iron allowance is most difficult to provide in the diet. Approximately equal contributions to the daily iron

intake are made by meat, poultry and fish, whole gram or enriched cereals and breads, and green or yellow vegetables. Certain fruits, peaches, apricots, prunes, grapes and raisins are excellent sources of available iron if they are eaten fairly often. While fruits and other vegetables, including potatoes, contain lesser concentrations of iron, the daily intake of these food groups may be sufficiently high to account for important additions to iron intake.

Iodine

Iodine is an essential nutrient for man because it is an integral component of the thyroid hormones, thyroxine and triiodo thyronine, both of which have important metabolic roles. The body normally contains 20 to 30 mg of iodine.

Function

Iodine functions as a contituent of thyroxine and other compounds synthesized by the thyroid gland. This is apparently the only role of iodine in the human body.

Absorption

Iodides are readily absorbed and excreted chiefly in the urine. Iodides absorbed from the intestinal tract are rapidly transported via the blood stream to the thyroid gland where they are oxidised to iodine and incorporated into the throxine molecules of thyroglobulin, converting them to thyroxine and triioidothyroxine.

Effects of deficiency

In the absence of sufficient iodine, the gland attempts to compensate for the deficiency by increasing its secretory activity and this causes the gland to enlarge. Ths condition is known as simple or endemic goitre. Endemic goitre of varying degrees is found among certain population groups whose sources of dietary iodine are limited. Foods grown on iodine poor soil contain insufficient iodine to meet human needs. The amount of iodine in the local drinking water may be regarded as a measure of iodine

content of soil. Endemic goitre does not occur when the iodine intake by adults ranges upwards from 0.075 mg per day.

Hypothyroidism which develops in foetal life or early infancy is referred to as cretinism. The two main causes for cretinism are insufficient thyroid in the new born because (1) the structure is defective or (2) the iodine intake of the mother has been inadequate. The face is puffy and there is a dull expression. There is no social smile. They have enlarged tongue. They are very lethargic and there is a tendency towards overweight.

Hypothyrodism acquired prior to adolescence is known as juvenile myxedema. It usually is suspected in an older child when he begins to lag or drop behind in school, loses interest, tires easily and has definitely delayed growth and development.

Requirements

The optimum daily requirement of iodine is 0.14 mg for an adult man and 0.10 mg for an adul twoman. Growing children and pregnant and lactating women need more. The need for iodine increases in pregnancy because the foetus must derive its iodine requirement from the mother. Maternal iodine is lost during lactation through secretion in the milk, so the minimum iodine requirement increases to almost one and a half times normal.

Sources

Among natural foods, the best sources of iodine are sea foods and vegetables grown on iodine rich soil. Dairy products and eggs may be good sources if the producing animals have access to iodine enriched rations. Most cereal grains, legumes and roots have low iodine content.

Of the various methods that have been proposed for assuring an adequate iodine intake, especially among populations in iodine poor regions, the use of iodized salt (1 part potassium iodide to 10,000 parts of salt) has thus far proved to be the most successful and therefore the most widely adopted method.

Fluorine

Fluorine is normally present in the bones and teeth, and a proper intake of this element is essential for maximum resistance to dental caries or decay. For these reasons fluorine is considered as essential nutrient. The beneficial effects of fluorine in the prevention of dental caries is particularly evident during infancy and early childhood and persists throughout adult life.

Intake of Fluorine

Fluorine is widely but unevenly distributed in nature. – It is found in many foods, but sea foods and tea are the most significant dietary sources. An average daily diet provides 0.25 to 0.35 mg of fluorine. In addition, the average adult may ingest 0·1 mg daily from drinking and cooking water that contain 1 ppm of fluorine. For children of 1-12 years old, water may contribute anywhere from 0.4 to 1.1 mg of fluorine per day.

Fluoride Excess

The fluoride content of water increases, sometimes excessively, when it passes through rocks and through soils of certain composition. Use of such water supplies leads to dental fluorosis, characterized by mottling of the enamel of the teeth. This condition is endemic in a number of communities where the natural water supply contains more than 2 ppm of fluoride. The fluoride content of such water can be reduced by iron exchange treatment.

Other trace elements essential for Human Nutrition

Trace elements other than iron, iodine and fluorine, which are reported to have beneficial effects in human subjects are zinc, magnesium, copper, chromium, selenium, cobalt and molybdenum. Deficiencies of most of these elements have been reported in human diets. Role of few of the trace elements is given below.

Copper

Copper (Cu) is a component of the enzymes tyrosine and uricase and is probably associated with other ozidation-reduction

enzyme systems. It is believed that copper facilitates the absorption of iron, and it appears to play a role in the synthesis of iron into haemoglobin and cytochrome molecules, but the exact mechanism for this haematopoietic role has not been established.

Selenium

Although the need for selenium (Se) seems to be adequately documented for laboratory and farm animals, no corresponding deficiency is known in man. There are, however, reports suggesting that selenium deficiency may be a complicating factor in certain types of protein-calorie malnutrition in children. It has been claimed on the basis of animal experiments that high levels of selenium promote dental caries, and there is some evidence that the same may be true for humans.

Sufficient evidence is not available for the establishment of human requirements.

Cobalt

The discovery, in 1948, that vitamin B_{12} (cyanocobalamin) contains 4 per cent cobalt (Co) proved this element to be an essential nutrient for men. Cobalt is present in many foods, in cooking utensils, and even in the atmosphere, atleast in industrial cities. A deficiency of cobalt in ruminants results in impaired growth, listlessness, progressive emaciation, and varying degrees of anorexia.

Cobalt is readily absorbed in the human intestinal tract, but most of the absorbed material is excreted in the urine; very little of the element is retained. The retained cobalt serves no physiological function since human tissues cannot synthesise vitamin B_{12}. There is no known human requirement for the element, except for that contained in vitamin B_{12}.

The requirement of cobalt is signified by the requirement of vitamin B_{12}

VITAMINS

Vitamins are organic substances which the body requires in small amounts and they have to be provided by the diet.

The term vitamin was introduced in 1912 by the Polish Biochemist Casimir Funk with the belief that all these substances were "Vital amines". At first, as the vitamins were discovered, they were identified by letters of the alphabet. Later, as each vitamin was isolated in pure form and its chemical structure was determined, it was given a chemical name. These chemical names are now their correct designations, although the original and more familiar letters are still used in the following examples.

Vitamin A_1 — Retinol

Vitamin B_1 — Thiamine

Vitamin B_2 — Riboflavine

Vitamin B_{12} — Cyanocobalamin

Vitamin C — Ascorbic acid

Vitamin D_3 — Cholecalciferol

Vitamins have long been classified into two groups — water-soluble and fat soluble based on their solubility. Water-soluble vitamins if are taken in excess, are excreted in the urine. On the other hand, the fat-soluble vitamins cannot be excreted in this way. Any excess beyond the immediate requirements is stored in solution in the fat in the liver.

Vitamins A, D, E and K belong to the fat soluble group and vitamins of the B complex and vitamin C belong to the group of water–soluble vitamins.

Retinol (Vitamin A_1)

Vitamin A which occurs in two forms, designated as A_1 and A_2 has several functions in the body. In its pure form vitamin A is a pale-yellow crystalline compound.

Functions and deficiency

1. Vitamin A is necessary to keep the several epithelial tissues in the body intact. Vitamin A deficiency results in morphological change in the epithelial surfaces of all parts of the body. The first mild symptom of epithelial changes in the eye are sensitivity to light. Epithelial cells undergo squamous metaplasia whereby they become flattened and heaped one upon another. The heaping up of the dry epithelium in conjunctiva produces the condition of Xerophthalmia. This is later followed by cloudiness and infection which leads to ulceration. The final stages of this disease brings about softening of cornea and leads to keratomalacia or permanent blindness.

Vitamin A deficiency may also result in phrynoderma a condition characterised by common type of skin erruptions. The skin becomes blocked with horny plugs of keratin so that their secretion diminishes.

The membranes lining the respiratory, gastrointestinal and genitourinary tract maintained in their optimum condition offer resistance to bacterial invasion; to that extent vitamin A gives protection against infection.

2. Retinol is essential for vision in dim light. The ability of the eye to see in dim light is dependent on the presence of the retinol pigment rhodopsin (visual purple), which is bleached in the presence of light. The bleaching of visual purple is the means whereby the human eye can see in dim light. Vitamin A deficiency leads to night blindness. But if this is not checked it may lead to total blindness.

3. Vitamin A is required for growth, normal skeletal development and tooth structure. In experimental animals foetal tissues develop with many malformations if vitamin A is not available.

Vitamin A deficiency falls most heavily on the young child. Twenty thousand young children go permanently blind every year in the world because of the lack of minute amounts of retinol

in their diets. It is believed that in India alone there may be over million cases of blindness arising from vitamin A deficiency.

Requirements

The recommended intake is 300 μg of retinol per day to infants rising to 750 μg for adults.

Sources

Retinol (A_1) is found only in foods of animal origin but it can also be manufactured in the body from the plant pigment a provitamin-carotene. One of these beta carotene is by far the most important source of retinol. Fish liver is a rich source of vitamin A. Milk, butter and cheese are fairly rich sources of vitamin A. Egg also contains significant amounts.

Carotene is supplied by fruits and vegetables which are dark green and orange in colour. Carrots and many dark green vegetables are very good sources.

Vitamin D

A number of distinct but closely related compounds called sterols, possess ricket preventing properties. Only two activated sterols are of importance in nutrition and thereapeutics. They are known as D_2 or ergocalciferol and D_3 or cholecalciferol.

Functions

1. It regulates the absorption and deposition of calcium and phosphorus in the bone.

2. Vitamin D is necessary for the proper growth and development of the bones.

3. Vitamin D has also a direct action in the kidneys where it promotes tubular absorption of phosphate.

Deficiency

A deficiency of vitamin D leads to inadequate absorption of calcium and phosphorus from the intestinal tract and to faulty mineralisation of bone and tooth structures. The inability of the soft bones to withstand the stress of weight results in skeletal malformations. This condition is named as rickets if it occurs in infants and young children. When the condition occurs in adults it is known as osteomalacia.

In rickets the skull is soft, the bones are fragile. The bones become bent under the weight of the body resting upon them and cause 'knock knees' or 'bow legs'. There may be project on of the sternum as in 'pigeon breast', narrowing of the pelvis and changes in the spinal cord. There is pot belly being the result of weakness. Nodules of abdominal muscles, beads can be felt at the sternal ends of ribs forming rachitic rosary.

In osteomalacia there is softening of the bones which may even lead to deformities. There may be pain in the legs and general weakness.

Recommended allowances

A daily intake of 10 mg of cholecalciferol is recommended for infants and children to their seventh birthday to prevent rickets and to ensure that the dietary calcium is absorbed in sufficient amounts. Adults need some vitamin D. When the vitamin benefits from sunshine are not available, cholecalciferol can be toxic also.

Sources

Natural foods are poor sources of vitamin D although small amounts are present in egg yolk, liver and fish. Fish liver oil is the most potent source. When the body is exposed to bright sunlight, 7-dehydrocholesterol found under the skin is converted into vitamin D which can be utilised by the body.

Vitamin E (Tocopherol)

Vitamin E activity is exhibited by a number of compounds of related chemical structure. Alpha tocopheral is the compound possessing the greatest vitamin E activity.

Functions

Vitamin E protects both carotene and vitamin A from oxidation in the digestive tract; so it has antioxidant properties.

Vitamin E plays a role in preventing autooxidation of polyunsaturated fatty acids in the tissues. Vitamin E can prolong the life of red blood cells. Vitamin E is necessary for normal reproduction in many animal species.

Deficiency

A deficiency of vitamin E in various species of animals results in reproductive failure, macrocytic anemia, shorter life span of red blood cells and weak muscles.

Requirement

The requirement for vitamin E increases as the intake of fat linoleic content in the diet are increased. The allowance for infants is 3 to 6 IU of vitamin E, for children and adolescents the range is 10 to 25 IU, for adult male and female 30 IU and 25 IU respectively.

Sources

Oils of wheat germ, cotton seed, rice germ and germs of other seeds are potent sources of vitamin E. Appreciable amounts are present in dark green leafy vegetables, nuts and legumes. Foods of animal origin are low in this vitamin.

Vitamin K

Refers to a group of substances of similar biological activity. Vitamin K_1 was isolated from alfalfa and K_2 from putrified fish meal. Vitamin K is fat soluble and its activity is easily destroyed by irradiation.

Functions

Vitamin K is necessary for the formation of prothrombin, a constituent of normal blood. Prothrombin is required for the clotting of blood. This vitamin K is necessary for coagulation of blood and the vitamin is also known as antihaemorrhagic vitamin.

Effects of deficiency

A lowered prothrombin content of the blood and increased tendency to haemorrhage result from deficiency of vitamin K. Hence it is sometimes called the Antihaemorrhagic vitamin. New born infants show susceptability to haemorrhage because the intestinal bacteria of the new born infant is not sufficiently developed for the synthesis of vitamin K. Therefore it is necessary at times to administer vitamin K to mothers just before delivery of a child or to the child upon delivery as a preventive measure againts this disease.

Requirements

No quantitative estimate of vitamin K requirement has been made for human beings but it is known that materials containing vitamin K activity in doses of 1 to 2 mg will correct vitamin K deficiency in most cases. A single dose of 1 mg of vitamin K immediately after birth is adequate to prevent haemorrhagic disease.

Sources

Vitamin K is found in green leafy vegetables especially cabbage, spinach, kale, lettuce, cauliflower, tomatoes, wheat bran, soyabean, cheese, egg yolk and liver. Vitamin K_2 has been shown to be formed by bacterial action of the flora of the human in lower intestinal tract.

Water Soluble Vitamins

The water soluble vitamins comprise the B complex and vitamin C.

Ascorbic acid or vitamin C

Of all the vitamins, ascorbic acid is the most easily destroyed vitamin. The oxidation of ascorbic acid is accelerated by heat, light, alkalies, oxidative enzymes and traces of copper and iron.

Functions

Ascorbic acid is essential for the production of collagenous or intercellulor material which holds the cells in proper relation to each other and for the healthy development and maintenance of the walls of the capillary vessels. The dentine of teeth, the bones, the cartilage and the connective tissues, are dependent upon this function. The maintenance of this function helps to explain the importance of vitamin C in wound healing and resistance to infection. Ascorbic acid has many functions in the body related to cell respiration and to the functioning of enzymes.

Deficiency

Poor wound healing, irritability, retardation of growth in the infant or child, and increased susceptibility to infection are some of the signs of deficiency. Scurvy is the deficiency state seen among the infants. Pain, tenderness, and swelling of the thighs and legs are frequent symptoms of infantile scurvy. The baby shows a disinclination to move and assumes a position with legs flexed for comfort. He is pale, irritable and cries when handled. Loss of weight, fever, diarrhoea and vomiting are present. Gums are swollen, tender and bleeding. Bone displacement results. Scurvy in adults include symptoms such as swelling, infection and bleeding of the gums, tenderness of the legs, anemia and haemorrhage. The teeth becomes loose and may be lost. There is degeneration of the muscle structure and of the cartilage generally. Thus this vitamin is also known as the antiscorbutic vitamin.

Requirements

The recommended intake for normal adults is 50 mg and for children 30-50 mg. This is at least three times the minimal require-

ment and provides a large margin of safety which is important since fruits and vegetables vary so much in ascorbic acid content and losses in cooking and preparation may be considerable.

Sources

The distribution of the vitamin in foods is uneven. Fruits especially citrus fruits are rich sources, green vegetables are useful sources, but they contain highly variable amounts much of which may be lost in preparation and cooking. Root vegetables such as potatoes are not rich sources, but since large quantities may be eaten, they can meet requirements. Animal products—meat, fish, eggs and milk contain only a little.

Chemically synthesised ascorbic acid is now readily available at reasonable cost. It is the best source for preventing scurvy in an emergency.

Thiamine (B_1)

This vitamin is readily soluble in water. This vitamin is stable in dry form. Cooking foods in neutral or alkaline medium is very destructive.

Functions

Thiamine as part of the enzyme carboxylase functions in the release of energy from the metabolism of carbohydrate. Thiamine is related to normal appetite. It is necessary for the normal muscle tone of the gastro intestinal tract and prevents constipation. It is necessary for a healthy nervous system.

Deficiency

The individual who is deprived of small amounts of thiamine daily builds up in increasing deficiency state which may be characterised by fatigue, lack of interest, loss of appetite, weight and strength. The patient may complain of indigestion, constipation, headache, fatigue and feeling of numbness and burning of the feet.

Prolonged deficiency of thiamine in the diet of the human, is one of the main factors in the causation of the disease called

beriberi which manifest in one or two forms wet and dry beri beri. Dry beriberi is a chronic wasting disease which leads to paralysis of the limbs and multiple neuritic symptoms. Wet beriberi is more acute form of the disease which causes edema and cardiac failure and sudden death. Infantile beri beri is common between the second and fifth months of life in children who are being nursed by mothers subsisting on beriberi producing diets. An acute disorder causes sudden death.

Dramatic recoveries occur in a few hours when an injection of thiamine (anti beriberi vitamin) is given to a patient with wet beriberi and to an infant with beriberi. The paralysis associated with dry beriberi does not respond to such treatment, although a little improvement may slowly follow after general dietary change.

Requirements

Since thiamine is essential for the utilisation of carbohydrate in the body, the requirements for the vitamin is closely related to carbodydrate intake. It has long been customary to express thiamine needs in terms of milligrams per 1000 kilocalories.

Sources

All natural foods contain thiamine even if only in small amounts. Plant seed contains a store that meets the needs of the growing plant embryo; hence whole grain cereals and pulses are good sources. Yeast is the only very rich natural source. Refined cereals and flours lack thiamine. Lean pork and liver are also good sources of thiamine.

Riboflavine (B_2)

The extract first called vitamin B_2 was known to contain mixture of growth promoting factors, one of which was isolated and shown to be a yellow pigment which was named riboflavine. It is sparingly soluble in water but disintegrates in the presence of alkali or light. Due to its heat stability and limited water solubility very little is lost in cooking.

Functions

Riboflavin functions as a coenzyme in a number of flavoproteins which are concerned with tissue oxidation. Riboflavine is necessary for the metabolism of amino acids, fatty acids and carbohydrates and their utilisation for energy. Riboflavine is necessary for growth.

Effects of deficiency

Riboflavine deficiency is called Ariboflavinosis. Ocular manifestations are believed to be among the earliest signs of riboflavin deficiency. The eyes become sensitive to light and easily fatigued. There is also blurring of vision, itching, watering and soreness of the eyes. An increased number of capillaries develop in the cornea and hence this leads to vascularisation of the cornea. Defieiency of riboflavin leads to cheilosis or cracking of the lips, glossitis (swollen and reddened tongue) and angular stomatitis (lesions at the corners of the mouth). Riboflavine deficiency should be diagnosed only when one or another of these conditions is shown to respond to treatment with the vitamin.

Requirements

Riboflavine requirements are related to body size, metabolic rate and rate of growth. Increased requirements for riboflavine occur whenever there is augmented metabolism in pregnancy, lactation, growth, fevers and stress of injury or illness. The FAO, WHO expert group recommends 0.55 mg/1000 kilo calories for all age groups.

Sources

Riboflavine is widely distributed in all foods, but in small amounts. Among the very best sources are milk (fresh, canned or dried); cheese is also good source.

Green leafy vegetables vary greatly but some are rich in riboflavine, as are most pulses. Whole cereal grains contain useful amounts, but these are removed in milling.

Liver, kidney and heart contain appreciable quantities of riboflavine.

Niacin

The discovery of the role of niacin as a vitamin of the B group is closely linked with the story of pellagra. The relation of niacin to pellagra was established when it is isolated from liver extracts and shown to have dramatic curative effects on human cases of pellagra. Both niacinamide and niacin function as a vitamin while nicotine does not. The term niacin was suggested to avoid association with the nicotine of tobacco. Niacin is moderately soluble in hot water. It is much more stable than thiamine and riboflavine and is remarkably resistant to heat, light, air, acids and alkalies, although small amounts may be lost in discarded cooking water.

Functions

Niacin is concerned with the utilization of glucose for energy and the synthesis of fats. It acts as a hydrogen transporter in tissue respiration.

Effects of deficiency

The symptoms of niacin deficiency are many. In the early stages, muscular weakness, anorexia, indigestion and skin eruptions occur. Severe deficiency of niacin leads to pellagra. It involves the gastrointestinal tract, the skin and the nervous system. It is also called the disease of the 3 D's because it causes Dermatitis, Diarrhoea and Dementia. While no two cases of pellagra are exactly alike, the following symptoms are characteristic. Early signs include fatigue, listlessness, backache, loss of weight, loss of appetite and poor general health. Sore tongue, mouth and throat with glossitis extending throughout the gastro intestinal tract are present. The tongue is red, the mouth becomes so sore that it is difficult to eat and swallow. There is deficient production of hydrochloric acid and this leads to anemia.

The skin develops a cracked pigmented scaly dermatitis in the parts exposed to irraditation. The dermatitis is characteristically symmetrical. At first the skin becomes red, somewhat

swollen and tender resembling a mild sunburn. If the condition is not treated, the skin becomes rough, cracked and scaly and become ulcerated. This may be followed with severe diarrhoea.

Lesions appear in many parts of the central nervous system resulting in confusion, disorientation, irritability, neuritis and dementia are noted as severity increases. Mental symptoms vary from patient to patient and even in the same person from time to time.

Requirements

It is reasonable to relate requirements to energy intake which as in the case of thiamine is expressed in milligrams per 1000 kcal. The amino acid tryptophan is a precursor of niacin and has a sparing action on the amount of niacin needed in the diet.

Folic acid group

Folic acid is a yellow crystalline substance, sparingly soluble in water and stable to acid solution. Several closely allied compounds have been identified in living matter - pteroyltriglutamate and pteroylheptaglutamate. These are converted to folic acid in the tissues and are known as folate group. Folinic acid is biologically active form of folic acid and also known as citrvorum factor.

Functions

Folic acid is necessary for transfer of single carbon units. It participates in synthesis of purines and pyrimidines and nucleoproteins and thus is necessary for regeneration of blood cells. It is necessary for biosynthesis of methyl groups. It is related to metabolism of certain amino acids like glytamic acids, tyrosine and phenylalanine.

Deficiency

Dietary deficiency is not likely to produce any symptoms, but may occur secondary to diseases like megaloblastic anemia of infancy and pregnancy. The symptoms are glossitis, diarrhoea, malabsorption and macrocytic anemia.

Requirement

Not known.

Sources

Fresh green vegetables and liver are the best sources. Beef, wheat flour, ham and eggs contain a little of the vitamin. Milk, fruit, mutton and poultry are poor sources. Appreciable loss occurs in foods stored at room temperature and during cooking.

Vitamin B_{12} (Cyanocobalamin)

This vitamin is the only known cobalt containing substance essential for life. It is soluble in water and is resistant to boiling in neutral solution though unstable in the presence of alkali.

Vitamin B_{12} is present in the body in several forms. This vitamin is obtained as a by product in fermentations which produce antibiotics like streptomycin. The absorption of the vitamin depends on the presence of castle's intrinsic factor, a mucoprotein enzyme secreted in the stomach. The intrinsic factor controls the level of absorption. Vitamin B_{12} is also known as castle's extrinsic factor. The vitamin is stored in the liver.

Functions

The vitamin is involved in purine metabolism and synthesis of nucleic acids and mucoproteins. It is necessary for synthesis of amino acids like choline and methionine.

It is essential for maturation of red blood cells in bone marrow and for metabolism of nervous tissue.

Deficiency

Deficiency occurs when there is a genetic defect in the production of intrinsic factor and this results in pernicious anemia abnormal cells - megaloblasts are seen. The nervous system is also affected and this may lead to degeneration of the nerve fibres.

Vegetarian diets deficient in Vitamin B_{12} retard growth but do not produce anemia.

Requirements

About 3 to 5 mg daily.

Sources

Occurs in minute quantities chiefly in animal tissues. Liver and kidney are good sources. Milk, eggs, cheese, muscle meats contain fair amounts.

Biotin

This vitamin is also known as anti egg-white injury factor. The vitamin is soluble in water, susceptible to oxidation and to alkali and strong acids. It is stable to heat.

Functions

It is synthesized in the intestine. Antibiotics interfere with synthesis. Raw egg white contains a particular protein-avidin which combines with biotin in intestine to prevent absorption. Avidin is inactivated by cooking. Biotin is one of the most active biological substances known. Extremely small amounts have marked effects on the growth of yeast and certain bacteria. It forms part of several enzyme systems, notably are that fixes carbon dioxide.

Deficiency

Deficiency is unlikely in man. Experimental deficiency can be produced in man by use of 200 g dried egg white. The symptoms are dermatitis of arms, legs, nervousness, anemia and pallor.

Rats fed on raw egg whites have spectacle eye, falling out of hair, loss of weight and loss of muscular control.

Requirement

Not known.

Sources

Biotin is present in a variety of bacteria free foods. Liver, kidney and yeast extracts are good sources; pulses, nuts, chocolate and cauliflower are fair sources.

Water

Another very important item in our diet is water. As a ready reckoner, a person's requirement for water is equal to his caloric requirement. Water is obtained from the fluids people drink, solids they eat and from oxidation of energy foods. Water is absolutely necessary for digestion, absorption, regulating body temperature, for removing waste matter, for transporting nutrients and substances and for lubricating the joints.

DIFFERENT FOODS AND THEIR NUTRITIONAL CONTRIBUTIONS

Foods are classified in different ways from the nutritional point of view. They can be grouped as "energy giving", body building foods and regulating foods. According to their origin they can be classified as plant or vegetable foods and animal foods.

Plant foods can be broadly classified as cereals millets legumes and pulses, vegetables, fruits, nuts and oilseeds, condiments and spices. Animal foods can be classified as eggs, milk and milk products, meat, fish and poultry.

Foods of vegetable origin—cereals and millets

Cereals and millets include wheat,bajra (cambu), jowar, (cholam), ragi, barley, rye, maize and other millets. They have been the staple of human food from very early times in all countries. They supply the bulk of calories in many national dietaries, particularly in India and in several Asian countries and Africa. Their protein content varies from 6 to 12 per cent. Because they are comparatively inexpensive and are consumed in large quantities they can be an effective source of proteins, particularly for low income groups.

Structure

All cereal grains have several parts, but the following are common to them all. The outer layer or bran is made up of

many layers of cellulose, minerals, proteins and small quantities of thiamine. The endosperm is the central portion of the kernal. It has mainly starch. It is the only portion which is left in highly refined cereal. This portion of the grain has better keeping qualities than whole cereal. The grain is the portion that sprouts, when the plant is allowed to grow.

Rice

Rice is the staple food for more than half of the human race. Chief areas of rice production in India are Assam, Bengal, South India, West Coast of India and certain smaller areas in each province.

The rice grain is a major source of Thiamine apart from contribution of starch. The protein and thiamine is rich when compared to other cereal grains. It contains 6-7 per cent protein. Calcium and iron are also lesser than that present in wheat and oats. Rice like other cereals is poor in fat. Rice eaters must depend on other foods for adequate supply of vitamin A and C.

Processing

There is one process which is widely applied both in the home and in the mill in the preparation of rice which has a great effect upon the content of B group vitamins in the final process. This is known as "parboiling' which means the steaming or boiling of unhusked rice after preliminary soaking. In parboiling process the paddy is soaked in cold or warm water for varying lengths of time followed by steaming till the grain becomes soft and partly or wholly cooked. Excess water is drained out and paddy is allowed to dry. Dry parboiled paddy is then hulled to give parboiled rice.

Marked changes are brought about in the nutritive value of rice as a result of parboiling. During steaming, thiamine and other water soluble nutrients from the germ and outer layers (pericarp) diffuse into the inner endosperm. Therefore when parboiled rice is milled, even if the pericarp and germ are removed, the loss of thiamine is less. Parboiling roughens grains and reduces percentage of breakage in milling. Milled parboiled rice is less easily attacked by weavils than milled raw rice.

Milling : In commercial milling which may include polishing, the outer layers pericarp and germ are largely removed and with them the colouring substances. The resulting white rice has an attractive white colour. The degree of milling determines the amount of nutrients removed. Proteins, fat, minerals and vitamins are lost.

Milling increases digestibility. Sudden change from milled to under-milled rice may lead to digestive disturbances.

Rice washed before cooking and when cooked in excess water, there is loss of water soluble vitamins like thiamine into the cooking water which may be completely lost when the cookingwater is discarded. Minimum water must be used for cooking so that no discarding of excess water is necessary.

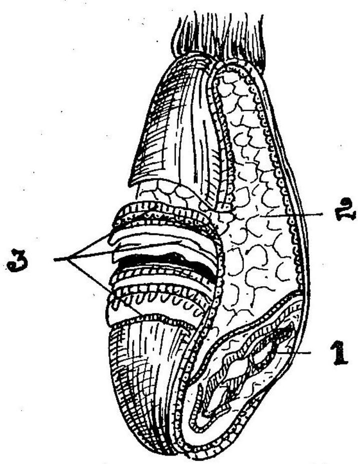


Fig. 31
Wheat Structure
1. Germ 2. Endosperm
3. Bran

Wheat

Wheat like rice grain consists of three parts—germ, bran and endosperm. The protein content of wheat varies from 6 per cent to 18 per cent depending on the variety; protein content of wheat flour ranges from 10-17 per cent. The pericarp has protein and mineral. The endosperm is mainly made up of starch. The embryo contains proteins, sugars, B vitamins, fat and vitamin E.

The outer layers of wheat can be removed by milling. Wheat can be made into refined flour or maida, which has starch mainly. Wheat can be made into flour or atta which has outer and inner layers. It is better than rice.

Ragi

Ragi is a millet used mainly in South India. Ragi protein is of good quality. Ragi has considerable amounts of calcium. Germinated ragi has vitamin C.

Ragi can be eaten as whole ragi, in the form of flour or as sprouted ragi. It is the cheapest cereal in many places. Ragi is commonly eaten as kali, roti, ragimalt and porridge.

Legumes and Pulses

A great many varieties of pulses are produced in India as grams, dried beans, peas and lentils. Pulses are richer in the body building material of proteins than cereals. They contain 20 to 25 per cent of proteins. They are also good sources of vitamin B and some minerals. Hence, it is important to include in the daily diet two to four ounces of pulses per person. This is particularly important in the case of growing children, if their diet is made up largely of milled rice. As the proteins of roasted Bengal gram dhal (channa ki dal) are of high biological value, it can be used as a good supplement to the children's diet.

When the whole grams are sprouted, vitamin C is made available from germinating sprouts. It is advisable to include sprouted grams daily in the diet, particularly when fresh vegetables are scarce.

Although pulses supply considerable quantities of proteins, their proteins are not of the 'First class' type. It has been proved that when the vegetable proteins are mixed with even little quantities of an animal food such as milk, the value of the mixture is greater than that of the components when taken separately.

Vegetables

Numerous varieties of vegetables are grown in different parts of our country. The number of vegetables available is so large that it is impossible to consider them. They individually can be broadly classified as green leafy vegetables, seed vegetables, fruit vegetables, stems, bulbs, tubers and roots. All these vegetables lend variety and nutritive value to the diet.

Despite the great variety of botanical structure, vegetables posses the same general nutritive properties though some nutrients

may dominate in certain vegetables. The value of vegetables as a source of energy is very small. The large bulk of vegetables helps to promote satiety and this with their low calorie value makes them useful in the prevention of obesity. Vegetables are also insignificant as sources of proteins and essential amino acids. All vegetables contain a large amount of indigestable fibre which helps in the bowel movement.

Green leafy vegetables: Leafy vegetables are the least expensive among the protective foods. They include amaranth, chekurmani, agathi, drumstick leaves, menthi leaves, mustard leaves, spinach, cabbage, cauliflower, lettuce and many other varieties. All these are easily grown and can be made available throughout the year from small plot of land. One or two drumstick trees in the yard are adequate to enrich the daily diet of families at no cost. They are all very rich in mineral and vitamins-calcium and iron, carotene, riboflavin, folic acid and vitamin C.

Seed vegetables: Tender cereals such as maize (corn) when used as vegetables in the diet are known as seed vegetables. Legumes such as beans, green peas when tender are also included in the group. They are valuable as sources of roughage, proteins and some vitamin such as vitamin C and carotene.

Fruit vegetables: Tomatoes, tender-jack fruit, unripe banana are examples of the group of vegetables. Among these, tomatoes and amla are rich in vitamin C. They are easily cultivated and can give three crops a year.

Other vegetables: A large number of the commonly used vegetables are included in this category. They are drumstick, lady's-finger, brinjal, pumpkin, snake gourd, bitter gourd, ridge gourd, cluster beans, field beans etc. These vegetables are inexpensive and can be easily grown in the kitchen garden. Drumstick has a high calcium and vitamin C value. Yellow pumpkin is rich in carotene.

Tubers and Root vegetables: Potatoes, sweet potatoes (white and yellow), yam, colocasia, carrots, tapioca, raddish, beatroot, turnip and other root vegetables contain a good amount of

starch, and in raw state, some vitamin C. Yellow sweet potatoes, potatoes, and carrots supply carotene also. Since these foods are starchy, they can take the place of cereals in the diet. Because of their high yield of calories per acre, sweet potatoes and tapioca are the least expensive among the energy giving foods.

Nuts and oils seeds: Groundnuts, cashew nuts, almonds, walnuts, gingelly seeds and mustard seeds are rich in protein, containing 18 to 28 per cent fats, minerals and vitamin B. Coconut is an exception to this. Gingelly seeds are rich in calcium also. Nuts and oil seeds do not contain vitamins A, D, C and B. Because of their heavy fat content, they cannot be eaten in large quantities but when taken in small quantities they make a valuable supplementation of protein and fats to the rice diet.

Oils: Oils of gingelly, coconut, ground nut, linseed and mustard seeds are the common sources of vegetable fats in our country. They are foods, but do not contain vitamins. The only exception is the red plam oil, which contain carotene. Vegetable oils are energy giving foods.

Fruits: Fruits supply roughage, vitamin C, carotene and mineral to the diet. They are useful in keeping the bowels healthy and active. Amla, citrus fruits and tomatoe are rich in vitamin C. Seasonal fruits such as mangoes, guavas, jambu pears are also good sources of vitamin C. Great attention is being paid in the Community Development Programme and the Applied Nutrition Programme (ANP) for producing several varieties of fruits through school and home gardens and making them available to all people. Papaya can be easily grown and obtained throughout the year for supplying carotene.

Dry fruits are useful to increase taste and palatability of foods.

Condiments and spices: Condiments and spices help to enhance the flavour of food. The essential oils present in them have curative properties and are believed to aid digestion

through stimulation of appetite and secretion of digestive juices. Garlic, ginger and asafoetida contain some factors which inhibit putrefactive bacteria in the intestinal tract.

Indian dietaries use the largest number of spices and condiments as compared to any other country. While a minimum quantity of condiments are desirable to enhance the flavour and palatability of food, care should be taken not to spend unduly large sums of money on condiments, particularly items such as dry chillies, which obviously do not add much to the nutritive value of the foods.

FOODS OF ANIMAL ORIGIN

Milk and Milk Products: Because of the presence in milk of body building material i.e., proteins, minerals, fats and vitamins in proper proportions, milk is considered to be nature's most complete or nearly perfect of all foods. Milk is an efficient supplement to the incomplete proteins of cereals, fruits and vegetables. It makes good many of the deficiencies in rice dietaries. It is however, deficient in iron and vitamin C,

Milk should be an important item in ones diet because of its first class proteins of high biological value, easy digestibility, richness of vitamin A, riboflavin, calcium, and other essential factors. It is a 'protective food' essential for body building. But unfortunately milk is scarce and expensive in many parts of India. The poorer classes cannot afford milk even for their growing children. It is, therefore, essential that we should increase the milk production in this country. Its increased consumption would help our children grow healthier and stronger.

Curd and Butter milk: Curd and butter milk are prepared from milk by fermentation. The nutritive value of curd is the same as that of milk. Curd has been an important item in the diataries in many parts of India from time immemorial. In countries with tropical climate, milk can be preserved longer if fermented in the form of curds. In curds two-third of the milk sugar is broken up, and some part of fat is split up into

simpler forms. For this reason curd is easily digestible. It is an excellent supplement to vegetarian diets.

Butter is milk fat. It is one of the main sources of fat soluble vitamins A and D. When butter is heated to a high temperature, ghee is formed. Ghee can be preserved for long periods without spoiling. It should, however, be pointed out that intense heat, so necessary for making ghee, destroys some of the valuable vitamin A. Since hydrogenated fats which resemble ghee are now being increasingly used to adulterate this valuable product, special care should be taken to see that the ghee purchased is pure.

Mutton : Mutton consists of muscle and varying amounts of fat and connective tissues, depending upon the part of the animal body from which it is cut, the age and the condition of the animal. Mutton contains 18 to 22 per cent of 'first class proteins' of high biological value. Meat is a good source of vitamin B but does not contain vitamins A, C or D.

Organs such as the heart, liver, kidneys, brain and intestines also contain iron and vitamins. Liver is the richest store house in the body of many nutrients. It is rich in proteins (18 to 20 per cent) of high biological value, and vitamins A, D and B complex. It is the richest natural source of vitamin B_{12}.

Fish: Fish provide a food source of 'first class proteins' of high biological value (18 to 22 per cent), and of vitamin B. Fish livers are rich in vitamins A and D. Fish and its bones are a rich source of calcium. All fish contain a fair amount of phosphorus.

There is a great variety of fish in the coastal areas of our country. The perennial rivers, inland lakes and ponds also supply fish.

Fish and meat can be preserved as dried foods and can be used throughout the year.

Egg: Egg is composed of the shell (which is porous), two membranes within the shell, the white a thin membrane separating the white from the yolk, the yolk and the germ spot. The egg is 11 per cent shell, 57 per cent white and 32 per cent yolk. This proportion may vary. About three fourth of egg is water.

Eggs have low fuel value. They are valuable source of protein which is complete and of high quality. Egg white has protein and only traces of fat. One third of yolk is fat, which is found n an emulsified form. Yolk has protein and is rich in phosphorus

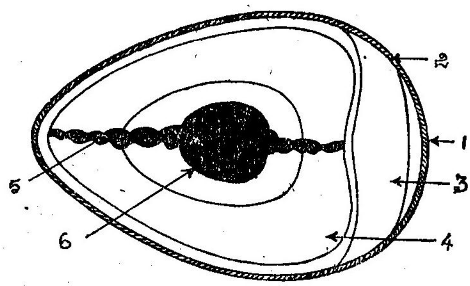


Fig. 32

Parts of an egg

1. Shell, 2. Shell Membrane of egg, 3. Air space
4. Egg white, 5. Chalaza, 6. Egg yolk.

and iron. Minerals like sodium, potassium and magnesium are also found in yolk. Egg has vitamin A carotene and B complex vitamins thiamine and riboflavin and small amounts of niacin and it is a poor source of vitamin D and vitamin C.

Eggs can be used in many ways in cooking. They perform at least seven different cooking functions—thickening, leavening, emulsifying, binding, coating, coagulating, colouring and flavouring. These functions are due to the qualities in egg, but most of them are due to the fact that proteins of egg coagulates under heat.

METHODS OF COOKING

Cooking is the preparation of food by the application of heat. We prefer many foods cooked to uncooked. They look better, taste better, are more digestible and more tender to eat than if eaten raw; flavour, texture, colour and nutritive value of foods are all effected by cooking which also prevents spoilage and adds variety to our daily menus.

The main purposes in cooking are three fold— (a) cooking normally increases palatability and digestibility of food (b) cooking enhances the nutritional balance of a dish by combining ingredients and (c) cooking destroys some of the harmful bacteria and enzymes.

I. Methods — using water as a medium of cooking

Boiling : Boiling is referred as cooking in liquid, mostly water in which bubbles rise continuously and spread over the entire surface. This method is used to cook pieces of food which by reasons of their size need thorough cooking. Dried cereals such as rice, dhal, gram and tubers like potatoes may require larger amounts of water. Cereals should be cooked in rapidly boiling water to gelatinize starch granules. Cooking water must not be drained because this will result in loss of nutrients. Vegetables should be cut just before cooking or serving and they must be cut into as big pieces as possible to minimise surface exposed to boiling water. Vegetables should be dropped in boiling water and boiled till tender, preferably without lid for the first five minutes of cooking. Salted or pickled meats and dry vegetables should always be started in cold water. Eggs can be cooked in shell by boiling method. Nutritional losses are usually due to leaching of minerals and water-soluble vitamins from the food into the cooking liquid.

Simmering : Simmering is cooking food just below boiling point. This method is used for cooking starchy vegetables. Foods that are simmered required less attention than boiling because there is less danger of burning through evaporation of the water. Salted meat are cooked by this method to remove excess salt used in preservation and the cooking liquid is thrown away, resulting in the loss of some minerals and B vitamins. Chicken, beef or mutton can be cooked in this way usually with vegetables and herbs to improve extra flavour. The cooking liquid can be used to make sauce or soup. Milk can be simmered.

Different terms are given to simmering according to the method used–poaching, stewing and braising.

Poaching : Poaching is slow simmering in a shallow open pan with a little water and this is used for such foods as eggs requiring fairly short cooking times.

Fish is sometimes poached particularly in milk. Some of the nutrients lost by leaching into the milk during cooking—minerals and B vitamins are retained by using the cooking liquid to make a sauce.

Stewing: Stewing is simmering slowly in a covered saucepan with sufficient liquid to cover the food. Certain varieties of fruit are simmered for a short time in sugar syrup to reduce toughness, to retain shape and improve flavour. The syrup is usually served with the fruit and so some of the nutrients are preserved in this way.

Stewing is also used to cook cheaper, tougher cuts of meat. The meat is cut into small pieces and simmered in stock with vegetables. Nourishment and flavour is retained when this method is adopted.

Braising: Braising is cooking foods, particularly flesh foods, slowly in a covered utensil in steam or in a small amount of liquid. Meat may or may not be browned in a small amount of fat before braising. Nutritional losses of vitamin B are usually greater by this method of cooking.

Steaming: Steaming is cooking food in steam without pressure. The steam may be applied direct to the food, vegetables, fruits, fish, dokhla, string hopper and rice preparations like idli, puddings. Meat, fish and poultry are cooked by steam. Several types of steam cookers are now available in the market. Potato and some starchy vegetables retain their shape better when steamed.

Steaming in a double boiler: This method permits cooking at low heat without the danger of scorching. Custards are cooked by this method. This method is suitable for cooking foods of delicate flavour. Nutrient loss is reduced as the food is not in contact with liquid but higher quantities of vitamin C are destroyed because higher temperature is maintained. The disadvantage encounted is that this takes a long time to cook. This method is not well adopted for cooking large and coarse pieces of foods.

Pressure cooking: This method is cooking by steam under pressure. A specially constructed container known as a "pressure cooker" is used. Foods cooked by this method retain the colour. Foods that need prolonged cooking such as tougher cuts of meat take much shorter time than usual. Losses of vitamin C and B_1 are about the same when compared with other methods of moist cooking.

II. Methods using fat as the medium

Frying: Frying is cooking in hot fat; food to be cooked should be added to the fat when a faint blue flame or smoke rises, for if heated much further the fat browns and finally burns. If food is placed in the fat before the flame rises, the fat penetrates and the food becomes soggy. If fried at very high temperature the food becomes brown and chars.

Shallow frying: Shallow frying is frying with little fat. The food should be turned from time to time in the hot fat until it is crisp and evenly browned. Mutton chops, cutlets, omelettes, eggs, paneer, vegetables and French toast may be prepared by this method. Shallow frying sometimes causes loss of vitamin A due to excessive heat and exposure to air and vitamins C and B_1 are likely to be affected.

Deep fat frying: Food is immersed in hot fat or oil and the food is cooked very easily and quickly. The pieces should not be too large as the heat will not penetrate to the centre and the outside may be overdone before the food is properly cooked. When food is cooked in hot fat, the sudden contact with hot fat, causes rapid evaporation of moisture in the food causing shrinkage, thereby sealing the outside. In this way the juices containing nutrients are prevented from escaping into the surrounding fat. Food for deep fat frying and sometimes for shallow frying is coated with egg and bread crumbs or batter to prevent fat soaking into the food and making it soggy. Food should be drained well on a paper to remove as much excess fat as possible before serving.

Rules for frying

1. Have the fat clear and hot.
2. Take care of the size of the food to be fried.

3. It is better you have coating for deep fried foods.

4. Choose fats which have high smoking point.

5. Follow time and temperature instructions carefully.

6. Choose fats that have high stability. Fats that become rancid quickly should not be chosen.

7. When oil darkens too much, cool and use it with a fresh supply.

Pan Frying: When a minute quantity of fat is smeared on the frying pan or sprinkled and the food spread on it and cooked the method is called pan frying. Parathas, dosais and pancakes are examples of panned preparations.

III. Methods using air as the medium

Baking: The food to be cooked is placed in a container or on a baking sheet in specially constructed oven built to conserve heat; the source of heat can be gas, electricity or solid fuel.

Although food placed in the oven is cooked mainly by converted heat, a small percentage of this heat is conducted first through the food. The temperature in the oven may be regulated between, 93° - 260° C (200° F - 500° F) so that a wide range of foods may be cooked. Baking is an even method of cooking, so that food can be left in one position and does not need attention during cooking. Baking temperature vary.

250° F - 350° F - Very low

350° F - 400° F - Low

400° F - 450° F - Moderate

450° F - 500° F - Very high.

The oven must be first brought to the required temperature. Not more than 15 minutes is required to bring it to moderate temperature. Adequate pre-heating of the oven before baking bread is essential. During baking crusts form at the surface of bread. The colour of the crust is darker than that of the crumb because the starch dextrimises and a browing reaction takes place between sugar and soluble nitrogen compound.

Food may be cooked in the oven with the addition of a little fat (basting) which helps to seal the outside of the food, preserve flavour and give a crisp finish, that is popularly known as oven roasting (300° F - 400° F is desirable). Large joints of meat may need basting two or three times or they may be covered with aluminum foil or cooking wrap to prevent them drying out too quickly on the outer surface.

Broiling: Broiling means cooking by direct heat. Broiling may be done over oven fire or under an open flame or under the wires.

Roasting: Spit roasting—cooking meat in an open spit over a fire.

Oven roasting: Cooking in an oven with addition of fat preferably at 300° F - 400° F. A meat thermometer is the best means of determining when roast is done. The thermometer is inserted to about the centre of the cut, no part of it should touch the bone.

Cooking by dry heat produces fairly high temperatures, which if prolonged may damage protein structure and destroy vitamins affected by heat. Dry heat causes shrinkages especially in meat tissues and therefore juices containing minerals may be squeezed out. Moisture in food evaporates quickly at high temperatures leaving the mineral salts concentrated on the outer surface of the food.

SIMPLE HOUSEHOLD APPLIANCES FOR FOOD PREPARATION AND STORAGE

Work in the house is an important constitutent, the physical accessories of which are equipment and household appliances. Now a days where paid help is expensive and when so many women work part or full time outside jobs with running a home, it is more than ever necessary to choose household equipment. The use of kitchen devices minimises time and strain in household work. The choice of essential equipments also depends on the taste of the housewife and the money available.

Hay box: The hay box is used to cook food with conserved heat. The hay box consists of a hollow wooden box with lid. The base of the box has a lining with hay four inches in thickness. There is a hollow in the centre, to place the vessel when ready.

Rice is partially cooked for 5 minutes, then the vessel is removed from the stove and kept inside the box. Then it is covered with a hay pillow which fits tightly into the hay box in order to have perfect insulation and the box is closed with a lid. The rice gets cooked in about two hours.

The principle involved is to utilise the accumulated heat over a long time by conservation. Hay, a bad conductor of heat is used in this box. Fuel and energy spent for cooking can be saved in cooking rice using this method. It is a poor man's heat storage cooker to save fuel. It is within the reach of even the average home maker.

Pressure cooker: Pressure cooker has become an accepted utensil in many kitchens and is the forerunner of today's labour saving devices. Cooking food under pressure is fast since high temperatures are used. It shortens the cooking process by preventing the escape of steam and thus increasing the pressure

and temperature inside the pan. Pressure cooking method saves fuel and energy and conserves the maximum nutrients.

Various types and sizes of pressure cookers are available and their cooking range varies. The instructions supplied with the cooker should be followed for good results. In general, a

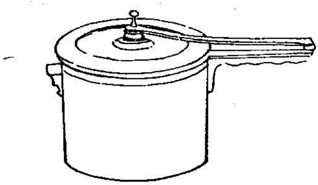


Fig. 33 A

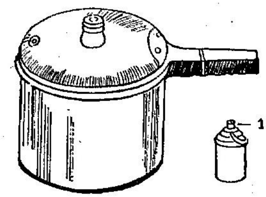


Fig. 33 B

Pressure Cooker

1. Pressure control — Automatic Airvent

pressure cooker consists of a pan with a heat resistant handle, a lid that fits tightly with a rubber gasket as a sealing ring, a safety fuse, an automatic airvent and a weight, which indicates the amount of pressure within the pan.

Hot plates: The working principle of a hot plate is that electric energy is converted to heat energy and is produced

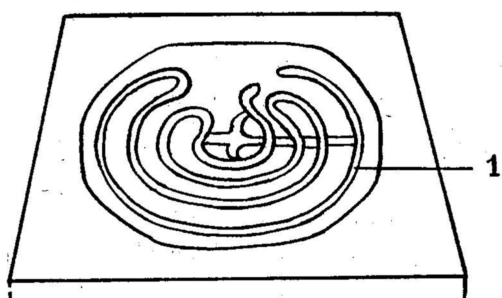


Fig. 34

Hot Plate

1. Metal coil

through the medium of resistant wires by radiation. Hot plates are of two types—the enclosed and radient type. In the enclosed

type of hot plate, the heating unit is enclosed with a metal plate whereas in the radient type, the heating unit is not covered. There are two types of Radiant Hot plates. They are open coil and Ring type.

Cooking by electricity does not produce flame, but simply makes it red hot; so there is no production of combustion and no soot is formed on the vessels.

Janata refrigera tor : The Janata refrigerator works on the principle of the cooling effect produced by the evaporation

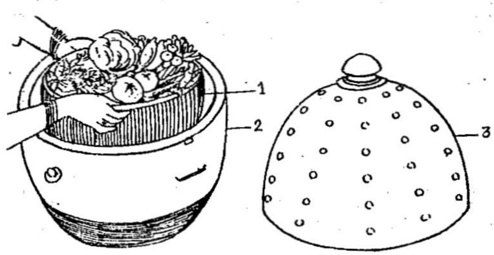


Fig. 35
Janata Refrigerator
1. Inner Pot 2. Outer pot 3. Lid with holes

of water. As the water in the outer vessel evaporates, the temperature inside the inner vessel is lowered.

The Janata refrigerator consists of an ordinary wa ter pot with a wide mouth. This is placed in a wider trough. Vegetables are put in the pot and placed in the trough of water. The pot is closed with an earthen ware plate which has holes for ventilation.

Flask: The thermosflask is so designed as to keep hot substances placed in it hot for a long time and cold substances cold.

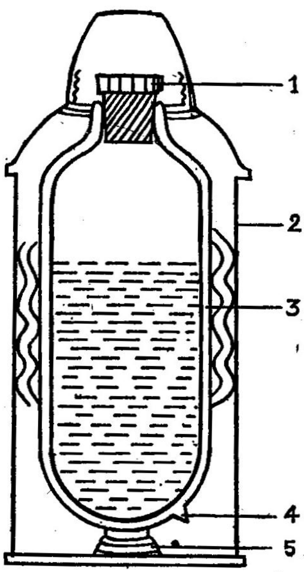


Fig. 36

Thermos flask

1. Cork
2. Outer cover (metal)
3. Inner cover (Glass-mercury coated)
4. Vacuum Bulb
5. Conductor

It consists of a double walled vessel of glass. The outer surface of the inner wall and the inner surface of the outer wall are silvered heavily and polished, the space between the walls is completely evacuated and sealed. The double walled vessel is placed inside on outer case, the vessel being lined with some non-conducting material. The vessel is closed with cork.

Since the materials used in the construction of thermosflask are very bad conductors of heat, loss or gain of heat due to conduction is minimised. The space between the walls of the vessel is a vaccum, no conduction or convection of heat is possible through the space. Gain or loss of heat by radiation is minimised by silvering the surfaces. Thus the flask keeps hot bodies hot and cold bodies cold.

CHAPTER III

Health and First Aid

WATER SUPPLY

Water is an indispensable need for living beings. What is water? Water is a liquid substance made up of two gases—oxygen and hydrogen. Two parts of hydrogen are united with one part of oxygen to form water. These gases are not just mixed as in air in which oxygen and hydrogen are parts of a mixture. They are united together chemically to form the new substance, water, which is of a different nature.

Importance of water : Water is very important for human existence. It is an essential requirement for human nutrition. It is required also for sanitary purposes such as washing clothes, cleaning utensils and the house. Water constitutes nearly three fourths of the weight of our bodies because every tissue and organ in our body contains water. Water is required for digestion and absorption. It is the carrier of nutrients and other body substances to the circulatory system. It helps to regulate body temperature, and removes waste from our systems. It is the chief component of all fluids and tissues.

Clean water is necessary for drinking, cooking, cleaning, bathing and other household purposes.

Some dreadful infectious diseases are caused by minute living creatures called micro-organisms, bacteria and viruses. They are commonly known as germs. Some of the disease producing germs live in impure air, in impure solid food and in impure water. The germs of cholera, enteric fever, dysentery and diarrhoea are found in unclean water and food and some types of worms also enter and live in the human body through these agents.

Therefore we need to be extremely careful about our sources of water and food. Where does your water come from? How is it brought to your home? Water may be obtained direct from rain water from the clouds and collected in a pool or in a cistern; from a spring, well, tank or river. It may be brought to the house by means of a pipe or a water cart.

Water which comes direct from clouds is in its purest form. It becomes impure by

1. Passing through the air in cities, picking up germs, soot, dust and other impurities.

2. Running on the surface of the land on which it falls.

3. Sinking into the ground and passing near human and animal habitations which are polluted by body wastes.

4. Pollution by people bathing and spitting or washing their clothes in tanks and pools. Sometimes people with skin dieseases and other contagious diseases bathe in tanks and rivers.

5. Coming in contact with sewage water when it is drained into the river.

6. Birds contaminating water in uncovered wells.

7. Those who bring water to our homes in unclean or infected containers.

8. Dissolving and carrying away certain harmful chemicals in its passage through the ground.

Different Sources of Water

Rain water: Rain water is soft. Therefore, if the usual supply is hard, it is advisable to store rain water and use it. If the rain water is collected in the plains, it is always contaminated by surface drainage. Even in the mountains, it should be protected and purified. If such pools are the only source of water in the plains,

one pool should be fenced and reserved for drinking, and water from the others should be collected only by special waterman.

Springs: Springs, formed by water gushing up from the ground owing to internal pressure, may be either surface or main springs. The water from main springs gushes up from a hole in a deep stratum of rock and may be generally safe. Surface springs are liable to surface pollution. Surface pollution of the ground means rendering the ground impure by the body wastes of human beings or animals.

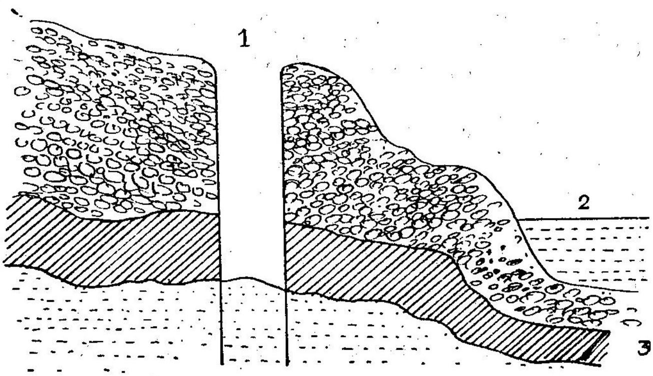


Fig. 37
Deep and Surface Water
1. Well 2. Lake 3. Impervious Rock layer

Wells: Water is present beneath any area of the earth's surfa e though sometimes one has to dig deep to tap it. Such sources of water or the deep holes we dig are known as wells. Being artificially made for human use, they are naturally dug near dwellings. Therefore, unless they are protected there is danger of surface pollution.

It is commonly known that the germs of many diseases pass out of our systems along with ordinary body wastes.

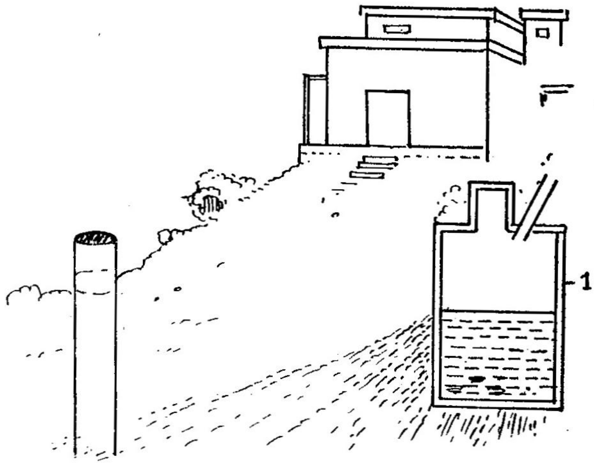


Fig. 38
Bad site for Well
1. Cess pool

When these are deposited on the ground, some of the germs sink below the surface and are carried by the next rainfall into

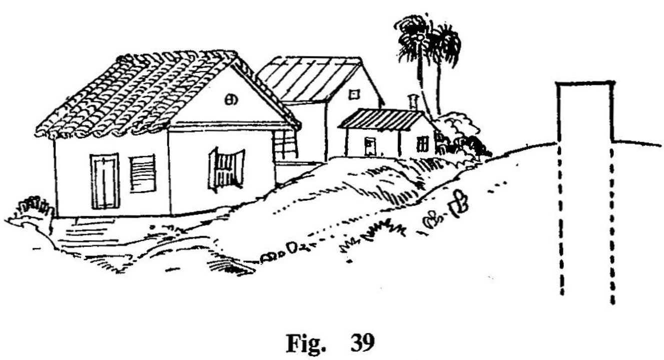


Fig. 39
Good site for Well

the nearest well or river or tank occurring at a lower level, thus rendering the water unsafe for drinking, bathing and other

domestic purposes. Therefore wells should be dug in areas of higher elevation than the houses to which they supply water. Wells are usually divided into three classes (a) Shallow wells (b) Deep wells and (c) Artesian or Tube wells.

Shallow Wells: These are wells in which water is reached before a layer of rock is encountered. Because of surface drainage near the house, this class may be considered as dangerous.

Deep wells: These are wells in which water is found below a layer of solid rock. The latter sometimes has to be blasted for the water to be tapped. The water below may be considered generally

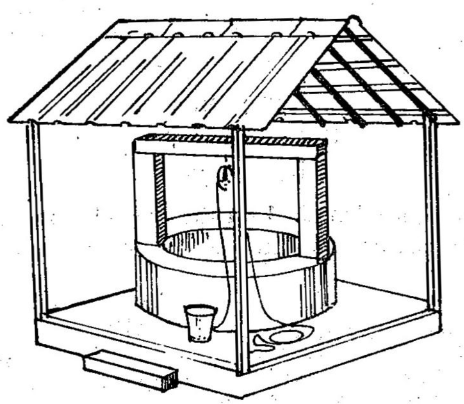


Fig. 40
Covered Well

safe, but the lining of the well to a depth below the level where the impervious stratum is penetrated, or else to a depth of eight metres, should be of cement or some other non-porous material. The surface of the ground should slope away from the mouth of the well. All wells should be protected by a roof or a cover as shown in figure.

Artesian or tube wells: Artesian wells were first sunk at Artois in France. Due to the vast amount of subterranean water these wells receive a perpetual supply from the water which rises

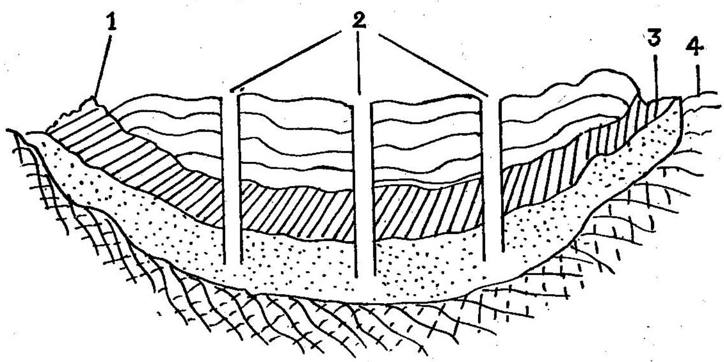


Fig. 41

Artesian Tube Well

1. Water - bearing Rock layer   2. Artesian wells
3, 4. Impervious Rock layer

by its own force to the level of the opening of the iron tubes hammered deep into the grounds by means of machinery.

These tubes within the ground send water through it to the surface. As in deep wells, water from Artesian wells is pure. The opening being small can be protected easily. This source is considered to be the most safe. Water from main springs and deep wells is usually pleasant to taste.

Water from tanks: Water from tanks may be contaminated from surface pools and animals. If used as the source of supply for a town or village, it must be protected and carefully purified before being distributed for domestic consumption.

Rivers: River water may be polluted in the same way as pools and tank water, with the additional risk of contamination from city drains. However, oxygen in the air under the influence

of sunlight has a remarkable effect on river water especially if the river is rapid and has many ebbs and falls. Water plants, too, release a constant supply of oxygen, which helps purification. Nevertheless, river water even at a distance from human habitation, must be purified for drinking purposes.

Distilled water: Distilled water is obtained by heating and trapping in cooled tubes. The vapour passes through the metal tubes immersed in a container through which cold water is allowed to run continuously. The vapour in the tube condenses and passes out as distilled water. Distilled water is as pure as rain water.

How water can be purified

Water brought through main pipes from large tanks or rivers is usually passed first into large reservoirs, in which it is left for a few days, or even weeks, until all dirt and decaying matter sink to the bottom. The water then is generally clean (free from dirt), but not pure (free from germs). This clean water is then passed slowly through filtering beds made up of a layer of coarse gravel and another of sand, each about a metre in depth. Sand has the property of holding back disease germs. The beds must be cleaned

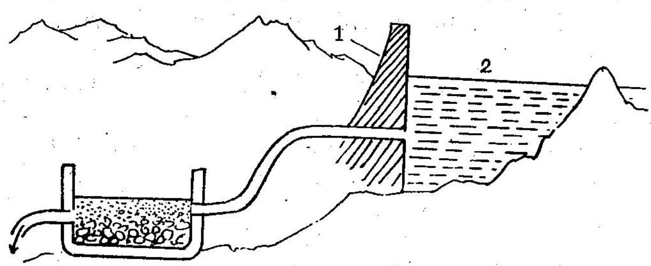


Fig. 42
Filter Bed
1. Dam 2. Reservoir

periodically, at least once every month. After filtration the water should be tested and if still found impure, it should be treated with chemicals which will destroy germs.

Impure water from the well may be purified by putting permanganate of potash in a bucket of water and adding this water to the well. The amount of potassium permanganate added will depend on the depth of the well.

Unless water is brought into the house in clean pipes and certified by the municipality, or carried in covered vessels by known healthy persons direct from a certified deep well or main spring, it is essential to boil water to be sure that it is safe to drink. If it is not clean, it should be purified with alum before being filtered.

Experiment : To clean water with alum

Put 170.4 gms of alum into 5 litres of water. Do not exceed the quantity of alum since the taste will then be very unpleasant. The alum combines with suspended and colloidal impurities and dirt and causes them to sink to the bottom. However, such water is still not pure. Only after boiling it becomes pure for drinking.

After being boiled, water should be carefully stored, preferably in porous earthenware vessels. When water evaporates, heat is given off. As water passes throughout the porous surface of the vessel continually, evaporation takes place, and cooling results. However, these vessels must be periodically cleaned with potassium permanganate and must be exchanged for new ones as soon as they cease to be porous.

Household Filters

Some people use filters, that is containers through which water is strained and purified. Such filters clean the water, but cannot be relied upon to get rid of the bacteria. The candle filter-in which the water passes through a fine porous porcelain candle shaped cleaner, is among the best. But it is very essential to renew the candle form time to time, as the pores get filled up with solid particles which form a good breeding ground for germs. Simple boiling destroys most disease germs. Thirty minutes are needed to destroy the germs of tetanus.

How does your school and your house get water? If it does not rise naturally, force is required, and this is usually supplied by a pump. Water from a cistern, or direct from the natural source, if placed at the right elevation, is distributed over the house in the pipes, and is let out when wanted by means of a tap, which is simply a little brass door opened and shut by a handle. The house wife should always see that the taps are properly turned off and do not drip. She should also know the point at which the house pipe enters the house from the main pipe called the main, and the means of turning off the water. The water should be turned off at this main if a leak has to be repaired and also if the house is left shut while the owner is away.

CARE OF THE SICK

Persons Caring for the Sick

Persons caring for the sick should be in sound health and should be free from communicable diseases like cold. They should be protected against common diseases by appropriate inoculations. They should always maintain a cheerful and sympathetic attitude towards the patient. As far as possible only washable clothes should be worn and these should often be washed and cleaned. The hands be dried thoroughly immediately after handling the patient or the article of his use. When running water is not available, water should be poured over the hands of the attendent.

Under no circumstances should an attempt be made to diagnose or to treat the patient without the help of the qualified doctor. The attendant should strictly follow the instructions of the doctor in the care of the patient. It is a good practice to write down the doctor's instructions so that the details may not be forgotten.

Patient's Record

It is necessary that a record of the patient's illness be kept. This is helpful in diagnosis and in studying the course of the disease.

The record should include :

1. Temperature–morning, afternoon and evening—every four hours.

2. Number and kind of bowel movements.

3. Nature and frequency of vomiting in a day.

4. Quantity of urine passed in 24 hours.

5. Quantity and variety of food taken.

6. Quantity and variety of liquids taken including water, fruit juices, tea, milk, etc.

7. Quality and duration of sleep.

8. Attitude of the patient (irritable, fearful, cheerful, drowsy, etc.)

9. Complaints the patient may have (abdominal pain, etc.)

Selection of Room: As far as possible the patient should have a room to himself. The room should be well lighted and ventilated. It should be near the bathroom and the toilet. Unncessary furniture, decorations, baggage and hangings should be removed. The windows should be kept open but should be well screened to prevent glow and draught coming directly on the patient. The room should be thoroughly cleaned and dusted every day. The floor may often be wiped with damp cloth dipped in an antiseptic solution like phenyle. Privacy should be provided to the patient. Discussion of the disease in the presence of the patient should be avoided.

Sick Room Equipment : In addition to a comfortable bed the equipment in a sick room should include: (1) A complete set of toilet articles for the patient, including a comb, a tooth-brush, soap, towel, bed pan, urine bottle etc. (2) A clinical thermometer,

soap and water for cleaning the theremometer before and after use. Disinfecting solution in a bottle for keeping the thermometer. (3) Clean handkerchief or pieces of soft cloth for wiping nose and throat discharges. (4) Ice bag or hot water bag. If running water is not available a pitcher of water, a basin, soap and towel should be provided. (5) It is desirable to have washable gown or apron for the attendant to put on while in the sick room. A hook or peg near the door may be used for hanging the gown when not in use.

The Bed : A firm but comfortable bed should be provided for the patient.

The bed cover and sheets should be washable. The mattress should be protected by a washable pad. For children and patients who cannot control body discharges additional protection should be provided through the use of a rubber sheet.

Changing the sheet under a patient : Gently roll the patient over to one side of bed. Uncover the soiled sheet and close up against the body.

Fold a clean sheet in narrow pleats and adjust on the uncovered matress as close to the patient as possible and tuck well at the side, head and foot of the bed.

Gently roll the patient to the side of the bed covered by the clean sheet. Withdraw soiled sheet, and pull the clean sheet in place.

Smoothen wrinkles and tuck tightly on the side and at the head and foot of the bed. All this can be accomplished without uncovering the patient.

Diet : The diet of a patient should be governed by the advice of the doctor. Until the arrival of a doctor it is usually safe to allow only liquids, such as, tea, coffee, fruit juices, etc.

Administration of Medicines : It is advisable to have a proper measure glass even if the dosage is marked on the bottle.

Before pouring out the dose read the label and shake the bottle.

Pour out the prescribed dose holding the glass at eye level. Read the label again before giving the medicine to the patient.

Make a note of the time for giving the medicine. The use of laxatives and enemas should be governed by the advice of the doctor.

All utensils used by the patient for eating and drinking should be washed thoroughly. These should be placed in boiling water for atleast three minutes and then washed with soap and water. These should be kept seperate from the other utensils.

Proper care of the sick adds to the patient's comfort and will do much to hasten his recovery.

The Household Medicine Chest : Every home must have a special medicine cupboard with a lock placed at a height out of the reach of children. The medicine chest should contain the simple remedies which might commonly be needed in emergencies. Never keep medicines from old prescriptions, as they lose their strengths and are not valid for conditions other than those for which they were originally purchased. Keep a few bandages, some cotton wool, a bottle containing sterile gauze or lint, a hot water bag, an eye cup, a clinical thermometer, a medicine glass, adhesive plaster, oiled silk, eucalyptus, vaseline, tannafax, camphorated oil, castor oil, potassium permanganate, tincture of iodine, boric acid powder, bicarbonate of soda, epsom salts, quinine, ammonia and aspirin.

WATER–BORNE DISEASES AND THEIR PREVENTION

Diseases are spread by several agents like air, dust, clothes and vessels, personal contact and by means of droplets. Droplets are tiny drops of water that are present in the air we breathe out. When we sneeze or cough the air that is forced out of our lungs contain these droplets in large number and these droplets contain

a large number of germs. Anyone who breaths this polluted air is likely to get that disease. Food and water and some kinds of insects also spread di eases.

Typhoid, cholera, dysentery and diarrhoea are some of the water-borne diseases. These are caused by swallowing the germs of these diseases through water or food and thus allowing them to reach intestines where they grow and multiply. It takes only two days to develop the symptoms of the disease. The germs are strong and are able to live a long time outside the body, if the sorroundings are kept damp. That is why they live so well in water and on moist food.

How do these germs get into water and food? That is the most unpleasant part of the story. As already seen they cannot get there except through the careless and unclean habits of people who have the germs in their intestines or the carelessness of those who look after the sick.

The active germs of typhoid, cholera, dysentery and diarrhoea enter our bodies through the water we drink. Faeces and urine which are carelessly disposed of may seep through the soil into tanks, wells or rivers. Further more, people who bathe in tanks after attending to nature's demands scatter germs of these diseases, which are then taken in by the other bathers, and by those who drink the water or use it for washing their mouths or utensils. Again, if the clothes of those who are sick or carriers of these diseases are washed in the water which others use for drinking and bathing they too spread the infection. In the succeeding pages we shall study about these in detail.

Typhoid: This is caused by a germ called Typhoid Bacillus. This is spread by contaminated water, food and also by droplet infection. Flies play an important part in the spread of this disease. These germs go into the body to form ulcers in the small intestines. There is high-fever which lasts for four full weeks. It starts with head-ache and pain in the body and high fever. Fever begins to fall gradually in the fourth week. The bacteria circulate in the blood during the first few days and can be cultured in the labora-

tory from a sample of such blood. The medicine used in the treatment of typhoid is chloromyecetine.

Cholera: This is very serious disease killing thousands of people quickly. This is caused by a germ called cholera vibrio. Man gets this disease by drinking water contaminated with these germs or eating contaminated food. Flies play an important part in spreading this disease. A person suffering from cholera will have violent motions and vomittings.

Personal protection from the disease can be had by taking anti-cholera inoculation. This must be taken compulsorily during an epidemic. Two injections taken at weekly interval will give protection against the disease for one year. Every case of cholera must be isolated. Intimation about the case must be given to the proper authorities. All contacts must at once take the preventive inoculation.

Dysentery: Dysentery means passing blood in the motion. Fresh blood is not passed but only digested blood which is usually blackish or dark brownish and combined with faecal matter. Two types of dysenteries are known. One is called Amoebic dysentery caused by the protozoan parasite, Entamoeba Hystolitica. Another type is called Bacillary dysentery caused by Bacteria. Both types of dysenteries are spread in the same way as cholera and typhoid by contaminated water and food, with flies playing a prominant part. The medicines used in Amoebic dysentery are (1) Emetine in the form of injections (2) Choloroquine tablets and (3) Indochlor Hydroxyquinoline tablets etc. For Bacillary dysentery sulpha guanidine tablets and other sulphur preparations and the modern antibiotics give complete relief.

Diarrhoea: People suffer from this disease mostly in summer and rainy season. It is spread by flies. There is frequent movement of bowels. If it is allowed to continue, it may take the shape of dysentery. It is caused due to the spread of bacteria by flies and due to taking of infected food, water and other drinks.

Safeguard against water borne diseases: In order to prevent water borne diseases we have to take great care to keep water and food always clean. By cleanliness is meant that there are no germs present. This is done by arranging for protected water supply. Many towns and villages depend upon wells and tanks for water supply. Some rules must be observed in the construction and maintenance of tanks and wells. A model well will have the following things:

It must have a parapet wall atleast three feet high around with a conical top to prevent people from putting their pots on it. There must be a cement platform all around the well so that all the water that falls down will be properly drained off. There must be a pulley arrangement to draw the water or a hand pump. There must be a separate bucket and rope provided there itself so that people do not put in their own vessels into the well and thereby introduce infection into it. Around the well there must not be latrines, trees or any sewage. A watchman must be employed to see that the people use the well properly. Now and then some bleaching powder must be added to the water in the well to kill all the germs. Bleaching powder contains chlorine which destroys germs. Tanks are also built on similar principles. The water which is to be used in the school for drinking purpose should be chlorinated properly.

The persons suffering from any one of the infectious diseases should be separated from others. Such thing would check the spread of the infectious diseases.

Prevention of diseases — Disinfection: Microorganisms can be fought only with the weapon of perfect cleanliness aided by disinfectant. A disinfectant may be solid, liquid or gas and one that will kill microorganisms. The disinfectants in common use are sunlight, heat, fresh air, ordinary household soap and freshly burnt lime. The house that is always well ventilated with plenty of light and air will not harbour germs. Germs will be killed if they are exposed to direct rays of the sun. Alternatively they are killed by heating to boiling point for five minutes though microorganisms causing tetanus require half an

hour's boiling. When an infectious disease occurs, it is good to disinfect all parts of the house by special means. In the case of epidemics of plague or cholera, the municipality must be requested to disinfect the house.

Special methods of disinfecting the house

1. Exposure of all articles to direct sunlight for a few hours.

2. In the case of textiles boil for half an hour with soap and water. If the textiles are stained, soak them in cold water. Disinfect that water before throwing it away.

3. **Exposure to steam:** This is very effective but requires a special apparatus.

4. **Burning sulphur:** Close tightly every door, window and ventilator in the room and fill up all cracks. If the air in the room is dry, boil a pan of water in it till the air is quite steamy. Place a metal tray in the floor and put on it a sigri containing a layer of red hot charcoal. For a room of 200 sq. metres place 2 kg. of pure sulphur on the charcoal, or place the sulphur in a pail, pouring in a little alcohol and setting it alight. As the fumes will affect your throat leave the room quickly closing the door tightly behind you. Leave everything undisturbed for sixteen hours.

Sulphur candles bought ready for burning are more convenient. Sulphur stains metal. Therefore remove or cover with oilmetal objects in the room before disinfection.

Exposure to formaldehyde gas: For a room of 200 sq. metres, 113.6 g. of pure sulphur will be adequate; close the room and dampen theair as indicated in method No. 4. Place $\frac{1}{4}$ kg. of crushed crystals of permanganate of potash in a pail in the floor and pour on it $\frac{1}{2}$ litre of forimalin. Leave the room quickly and close the door, allowing it to remain.

closed for six hours. Immediately a gas is formed which rapidly fills the room. Do not try to use sulphur or formaldehyde gas except under the supervision of an experienced person. Disinfectant which produce fumes or gas are called fumigants.

Use of solutions : A scottish surgeon Dr. Joseph Lister, used disinfectants to cut down deaths in child birth and surgery. He sterilized his surgical instruments with disinfectants like carbolic acid, which saved the lives of many patients after operations.

Solutions of carbolic acid, saponified cresol formalin or phenyle are useful disinfectants. They may be used with water for washing the floor and walls of rooms, for placing in sputum bowls or pans and for disinfecting drains. Always read the directions given on the bottles before putting them to use. Remember that they are poisonous and if kept in the house, should be placed on a high shelf out of reach for children. Many people think that permanganate of potash is a disinfectant. It hinders the growth of micro organisms in wounds but it cannot be relied upon to kill them. However it can be used to purify water of all organic matter.

If the floor of a room is to be disinfected and if it is made of earth or earth mixed with cowdung dig up the surface, remove the material collected outside and burn it. If this is impossible, spread lime or quicklime over the floor or soak the floor with a strong disinfectant solution.

During an illness do not allow others to use any article the patient has been in contact with, without disinfecting it. Keep aside special dishes, vessels, and spoons for the patient and wash them in his room or on a verandah outside. Wash and disinfect or sterilize by boiling sheets, clothes and other articles used by him. Body wastes should be disinfected by the use of the solutions mentioned above or by quick lime. Wash your hands in a disinfectant everytime after touching the patient, his bed, or any article used by him.

If there is anyone in your house suffering from tuberculosis remember that microorganisms from the sputum of the patient will float in the air and deposit themselves on the walls of the house. The patient should spit in a little vessel lined with paper over which quicklime is spread. The paper with its contents can be removed and burnt or buried.

Liquid disinfectants which are not poisonous or injurious to human beings may be sprayed on walls, into corners and into the air itself, when there is an infectious illness in the house. Because of the compression pump fine particles of liquid or oil vapour mixed with air come out of it when the piston works. Vapour of kerosine or other inflammable vapours mixed with air is highly explosive. Therefore never spray near an open fire.

Common colds are very infectious and when one member of the family has a cold, it generally spreads to the others. Disinfectants can check their spread. Micro-organisms which are brought in with milk may be those of tuberculosis from a cow suffering from tuberculosis and those of intestinal diseases probably deposited in the milk by flies. The remedy is to boil milk as soon as it comes into the house and then to keep it covered. Fruit and vegetables that are eaten raw should be thoroughly washed. Cooked food should be bought only from reliable suppliers who have not exposed it for sale in uncovered vessels.

Micro-organisms which may be found in the ground are those of intestinal diseases diarrhoea, dysentery, enteric fever and cholera. Other micro-organisms that come from the ground are those that cause hook worm and tetanus or lockjaw. Hook worm is contacted by picking up the minute hook worms through cracks in the skin of the feet. This group of diseases can be controlled only by the proper disposal of body wastes and scrupulous cleanliness of privies and latrines. A long handled brush should be kept specially for the latrines which should be washed well daily with a strong solution of soap and water with a disinfectant once a week or more often. Ceilings and walls of latrines should be white washed once a month. In the case of an infectious disease in the house they should be disinfected everyday.

Carefully distinguish disinfectants from deodorants and antiseptics. Deodorants simply hide unpleasant odours. They do not destroy microorganisms. Generally weak solutions of chemical disinfectants serve as deodorants.

Antiseptics

Dr. Lister reasoned that micro organisms caused the septic conditions which frequently followed surgery. By operating under a spray of phenol and using antiseptic dressings for surgical wounds, he successfully reduced post operative sepsis. Antiseptics hinder the development of microbes in wounds where perhaps stronger disinfectants might harm the patient. The best known antiseptics are boric powder, permanganate of potash and iodine.

Disposal of Household waste

Household wastes are of two kinds:

1. Organic—consisting of peels of vegetables or fruits and scraps of discarded dry food, paper and rags.

2. Inorganic—consisting mainly of ash dust and broken articles. The golden rule in the disposal of household waste is to compost all organic perishable rubbish. Keep a covered metal vessel (pail) with a layer of ash spread at the bottom and a lid provided with a handle for depositing all the waste. As soon as household waste accumulates empty it on top of this layer. The lid should always be in position in order to avoid flies; waste paper baskets should be kept in every room for disposing waste paper, rags or rubbish. If the quantity is small their contents may also be thrown into the covered pail.

What happens to the household waste matter that the sweeper carts away? It is safest and best to burn it. Sometimes it is dumped on low ground for the purpose of raising the latter. This

is not a good plan for if the ground on which waste is dumped is to be used as a building site it will remain unhealthy for some years. Sometimes, after the removal of broken china and tins, organic wastes are spread over fields and used as fertilizers. Care should be taken that such places do not become the breeding places of flies.

Civic consciousness means that you have developed a sense of right conduct towards your fellow citizens in relation to discarding waste. The house wife should see that her home and neighbourhood are kept clean and beautiful.

CLEAN HABITS TO KEEP THE BODY HEALTHY

Abstractly we look upon health as a condition of harmonic fluctuation between several parts, body and mental as well as harmony between ourselves as a whole and the outside world, including our fellow human beings. An adequate concept of health includes more than the existance of an almost passive harmony. It implies the making the most of ourselves and realising the best of which we are capable. The word itself signifies wholeness or haleness and is probably synonyms with holiness. WHO defines health as 'Health is a state of complete physical, mental and social well being and not merely the absence of disease or infirmity.'

Personal hygiene deals with matters pertaining to the health of the individual himself. To enjoy good physical and mental powers, one should learn to utilise them to his best advantage. Habit plays an important part in preservation of health. It is readily formed by practice and essentially becomes a part and parcel of nature, making its eradication a matter of great difficulty. It is for this reason that habit is called second nature. The influence of habit in the formation of the character of individual is known to all but its influence on the physical and mental conditions of men, particularly of children cannot be over estimated. The following features are more or less influenced by habit.

(a) Eating and drinking : Meals should be regular, nutritious and appetising. An adequate diet should provide adequate proteins, fats, carbohydrates vitamins and minerals. It should be able to supply sufficient energy to the body, to build up the tissues of a growing child and to replace wornout tissues. The ordinary mixed meals are usually adequate for all these purposes. At home special attention has to be paid to the diet of children, expectant mothers and lactating mothers, who require a diet rich in protein and of a high caloric value. Appetite is usually an excellent guide but when food is plentiful, over eating is likely to occur and may lead to obesity. Alcohol, as a rule, should be avoided and this very act of craving for it is an indication of ill health.

(b) Smoking : Smoking is extremely dangerous because it contributes to cardiovascular disease and bronchitis; it is liable to cause cancer of the lungs. There is a little doubt that cigerette smoking is the main cause of the disease, although other factors play a part in its production and the actual carcinogenic agent has not yet been identified. The more cigarette a person smokes the more likely he is to develop this disease. Pipe smoking is not as dangerous as cigarette smoking. Tabacco is a sedative, that can soon become an additive.

(c) Sleeping: Young babies sleep nearly all day, older babies for most of the day. Children need ten to twelve hours sleep in every twenty four hours. The amount that an adult requires shows individual variation of five to nine hours a night. According to their sleeping habits people may be divided into two classes, those who wake early and completely are at their best in the morning, evening and go to bed early and those who sleep in the morning, improve as the day goes on, are at their best at night, and go to bed late. Many people are refreshed by a short nap of ten or fifteen minutes in the middle of the day or early evening.

A bed room should be quiet, without glaring lights and well ventilated. The bed should have sufficient bed linen to keep a sleeper warm without making him hot. Some people and especially young children, sleep quite well with very few clothes over them.

(d) **Fasting:** Fasting means complete abstenance from all kinds of food except water at specified hours. A moderate fast should not extend over 24 hours. The effect of fasting for longer periods is to cause the body to live on its own reserve and to use up the stored superfluous fat and the partially assimilated material, at the same time to eliminate unwanted material accumulated in the body. During fasting daily duties may be continued without any discomfort but violent exercises should be avoided.

(e) **Evacuating the bowels:** One should cultivate this habit of evacuating the bowels at the same time, the convenient hour in the morning before starting the day's work. The failure to do so will result in chornic constipation. Constipation is really an evil of modern civilization. Sedentary habits and want of proper exercise lead to weakening of both the intestinal and abdominal muscle resulting in the stasis of the intestinal contents. Modern food contains less roughage which mechanically stimulates the peristalsis.

(f) **Work:** The amount and kinds of work that people do vary very much. Work must be within the physical capacity of the individual; and should be both suitable for his intelligence and temperament and emotionally satisfying. As people vary in physique, intelligence and temperament, so may vary in their choice of work.

Exercise and games

Some form of physical exercise is necessary if positive health is to be achieved and maintained, and people who do not get it in their work should make it through games or exercise. Physical exercise maintains the circulatory system in a state of efficiency, ventilates the lungs, promotes digestion, keeps the skin clean by perspiration and maintains efficiency of the voluntary muscles and the nervous system.

At schools, sports and games are organised as parts of the scheme of physical education. After a person has left school

the amount of exercise taken will largely depend upon his individual, efforts, interest and skills.

Rest and relaxation

Most people of regular work benefit from short rest periods, in which drinks and snacks may be taken, during the day. Fatigue may be the result of too much hard work done in too short a space of time, or inadequate ventilation in the place of work; or unsuspected disease; or of boredome produced by monotonous work, inactivity or lack of adequate stimulation.

Some people devote all their interest to their work and have little time or inclination for other activities.

Personal cleanliness

Skin: The skin is washed to remove dirt, dried perspiration, dead skin cells and micro organisms, and to give the body a pleasant smell. Daily baths are necessary for people with dirty work and during hot weather. A daily cold bath is often recommended as a stimulant and health promoting measure, taken before going to bed may promote sleep.

Washing the hands is very important. The hands should be washed after every visit to the lavatory, before preparing or eating food, before feeding children or others. The nails should be kept short by filing or cutting twice a week, should not be allowed to project beyond the tip of the fingers and should be kept clean with a nail brush.

Feet that perspire easily should be washed daily, a daily change being made of socks. The space between the 3rd and 4th and between 4th or 5th toes should be inspected for evidence of injurious infection.

A man's hair should be washed once a week or often if his occupation is a dirty one. A woman's hair should be kept clean and well groomed.

Clothing: Clothing is worn to keep the body warm and conserve heat in cold weather, as a protection from the sun, the wind and rain and for personal adornment. Clothing should be suitable for the work to be done and should not restrict movements or be too tight. Clothing may be made of natural substances such as wool, cotton and silk.

The material for dress should not produce harmful effect on the skin directly in contact with it. Children and very old people are very susceptable to changes of temperature. The dress should not interfere with the health of the skin. It should be light and warm and be suited to all climates and seasons.

Shoes

Shoes are worn for support of the foot, for protection of the foot from injury, cold, wet and dirt, and personal adornment. Shoes are usually made of leather because leather is both strong and slightly yielding, able to stand up the strains put upon them and hard wearing and can both let air thrush and absorb moisture from the foot. They should confer to the normal outline of the foot and should not squeeze or distort it, thus producing curves. It is better to have a size bigger than is actually necessary.

Bedroom slippers should be worn only in the bedroom and bathroom and as they give inadequate support to the feet, should not be used for walking about the house or working in it.

Children's shoes should be like man's low heeled, laced and with rounded toe caps, broad enough to take the toes comfortably. Children's shoes should be changed as the foot grows. Idealy a new pair of shoes of right size and shape should be bought when required. Well made sandals may be worn for part of the day.

Preventive measures against worm infestation

Parasites are creatures that live in or on the bodies of other creatures and do them harm. In tropical countries, they are a

common cause of serious human illness. Precautions must, however, be taken and there is always danger that travellers will bring a parasite that does not usually live here. Parasites may be external—living on or in the skin such as lice, scabies, mite, fleas and bed bugs or internal—living in the body such as thread worm, round worm, hook worm, tape worm, or guinea worm.

We will consider here preventive aspects of internal parasites.

Thread worm: Man is infected by swallowing the eggs. An already infected person can be reinfected by (1) contaminating his fingers with the eggs from his own perianal region and transferring them to his mouth and (2) the eggs hatching out in the perianal region and the larva crawling back up the anus into the colon.

Other people can be infected by (1) contaminating their fingers with the eggs (2) becoming infected from lavatory seats and (3) by swallowing eggs—shaken out of clothes and bed clothes. It is common to find several members of the family infected.

Prevention is by (1) careful washing of anal region and hands after having the bowels open. (2) Frequent washing of bed clothes and under clothes and the exposure of them to wind and sun (3) cleanliness of lavatory seats.

Treatment is by piperazine citrate or gentian violet.

Roundworm: The eggs pass out of the anus. They are very resistant. In damp earth they can live for atleast five years; ordinary sewage treatment does not always kill them and multiplies, in the concentration normally used have little effect upon them. Infection of man is through his mouth.

Prevention is by careful hygiene, the sanitary disposal of human excreta, training of children not to eat sweets that have dropped to the ground and treatment of infected soil by deep burial or exposure to steam.

Ring worm: Ring worm is due to fingers. Different varieties may affect head, skin, body and nails.

Particular care should be taken to avoid infection being, conveyed to others. All toilet utensils, soap, towels and especially brush and comb, should be kept separate. The child should sleep alone and should be as far as possible isolated from other children. He should be warned not to touch his head with his hand. If finds difficult, hand is covered by a cotton cap which can be boiled. Ring worm of the body varies in appearance. The ring worm of nails is characteristic with finger nails. The treatment of ring worm is oral administration of artificial antibiotics.

Hook Worm : Hook worm is common typical infection. There are two varieties Anhylortima deuodenal and nector amaricans. The adult worm attach themselves by their hooks to the wall of the small intestine, their eggs being excreted in the faeces. People particularly liable to be infected are those who walk bare footed and handle faecally contaiminated soil. Common evidences of infection are severe hypochromic microcytic anemia, malnutrition and itching at the site of invasion of the skin.

Prevention

Tape worm : The eggs die unless they are eaten by cattle, which can happen when cattle graze pastures infected with human faeces or sewage. Once swallowed, the embryoes appear from the eggs, pass through the intestinal canal, invade the tissues and settle down in striped muscle.

The preventive means include (1) obstinance from eating raw or imperfectly cooked pork, beef or fresh water fish (2) sanitary disposal of human excreta (3) careful personal and community hygiene (4) thorough meat inspection and (5) special precautions, where dogs are involved e.g. disinfection by D.D.T. deworming, care that dogs cannot get near food, crockery and children.

Guinea worm : Prevention of this disease depends on protecting drinking water from being infected by guinea worm patient. The cyclops (water fleas) are killed by heating the water or by adding a trace of potash. Wells and tanks which are approached by steps are the greatest sources of infection. There should be an arrangement for drawing water either by a pump or a bucket. The wells should be properly protected by a parapet. Barkel fish feed voraciously on cyclops and larvae of guinea worm and these may be introduced in tanks and wells with advantage. Simple straining of water through a cleanliness is often helpful.

Need to include greens and vegetables in the diet

Green vegetables consist chieflly of water, with a very small amount of protein and carbohydrate. Their dietetic value is due to the fact that they are rich in minerals, especially in potassium and iron and that they are a very important source of vitamins.

The amount of solid norishment in cabbage is very small. The effect of cooking upon green vegetables is still faster to reduce their vitamin and a good deal of their mineral content. Cauliflower is a useful and attractive form of vegetable. It is very easily digested. The green tops of turnips and other root vegetables should not be thrown away but should be utilized in the same way as cabbage. Spinach is one of the most useful of all vegetables. Mushrooms contrary to the popular idea, are not very nutritious. They contain in addition to water, a certain proportion of cellulose, a little nitrogenous water, salts and various substances to which they owe their flavour.

CHAPTER IV

Life in the Family and Population Education

PRENATAL AND POSTNATAL CARE

Having a child is a good and normal experience, an achievement for which a women's whole being prepares her from the moment of her own birth. The mature female body is designed to bear children.

About every 28 days, midway between two menstrual cycles, changes take place both in the ovaries and the uterus. An ovary gets ready to release a mature ovum. At the same time, the lining of the uterus starts to grow. Tiny glands and blood vessels appear in the top half of this lining and the whole of it becomes soft and velvety.

About 14 days before the menstrual flow, a single ovum leaves one of the ovaries, stops for about 24 hours at the entrance of the Fallopian tube and goes on through the tube into the uterus. If conception does not take place, the lining of the uterus generally stops growing and comes loose. As it loosens, the blood vessels which come away with it begin to bleed. This causes the menstrual flow of blood. It carries away the unused top layer of the lining of the uterus and any other waste materials that may be present. As soon as this first menstrual period ends, preparation for another one begins. The cycle repeats itself, except during pregnancies, until the menopause, when the child bearing part of a woman comes to an end.

When a baby is going to be formed, the situation is very different. Male sex cells (spermatozoa) enter the upper vagina in millions. These cells are much smaller than the ova, and move by shaking their long slender tails. Within a few minutes they swim through the cervix into the uterus itself and up through the Fallopian tubes. If there is an ovum in either of the two tubes,

a spermatozoan will usually succeed in entering and combining with it. This is called fertilization.

Growth begins

The process of growth of the fertilized ovum within the mother's uterus is one of absorbing interest. In the early stages, the developing child is known as the embryo. From three months until birth it is referred to as the foetus. During the period of development the fertilized ovum changes from tiny embryo into a fully developed child.

The embryo is attached to the body of the mother by means of a long cord, known as the umbilical or naval cord. One end of this cord is attached to the body of the developing child at the naval. The other end is attached to a fleshy organ, on the wall

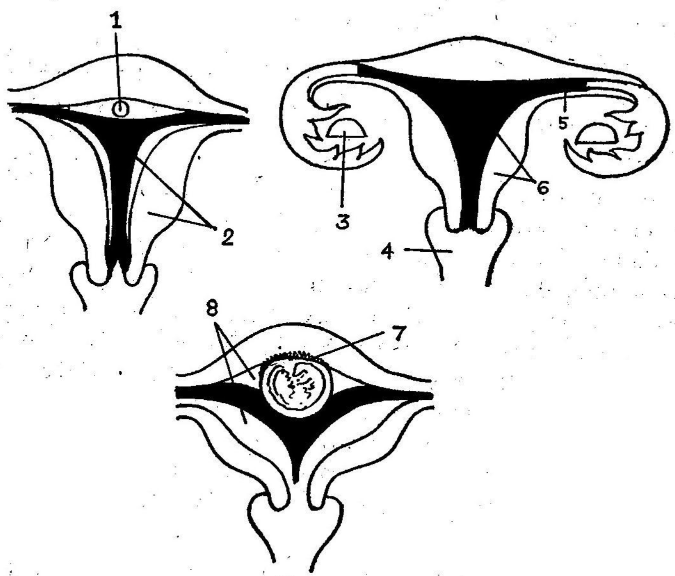


Fig. 43

The Female Reproductive System

1. Fertilized egg in Uterine Water 3. Ovary
2, 8. Mucous Membrane 4. Vagina 5. Oviduct
6. Uterus 7. Placenta

of the mother's uterus known as the placenta. It is through the placenta that the developing child draws its nourishment from the blood of the mother.

At the end of four weeks, the embryo is about half an inch long without any definite form. Soon, however, the features of the head develop, though it would be difficult at this stage to find any resemblance to a human baby. At about eight to twelve weeks, buds appear on the embryo and these develop into the limbs. The head at this stage is large and very much out of proportion to the rest of the body. By the end of the fourth month the fingers and toes are fully separated and bear soft nails and the foetus, which is about five inches long by now, possesses a definite human form. Towards the end of the fourth or during the fifth month, the mother can notice the beginning of a movement in her uterus. The movements will continue periodically until the baby is born.

One of the earliest provisions made for the protection of the embryo against injury is the forming of a sac or bag around it. This sac becomes filled with a fluid. This sac acts as a shock absorber in case of accidents.

Prenatal care

Prenatal care begins even before conception. The mother's good health is an insurance for the mother and the child. All the good habits that the mother has built up so far, will help her to prepare for the experience of having a baby.

1. Your food and your health

Regardless of the mother's age, the kind of work done by her and the area of living, her good health depends to a very great extent on the food she eats. This is especially true during pregnancy when she must satisfy her growing baby's needs for nourishment in addition to her own.

The expectant mother who regularly eats the right food while she is carrying her baby is more likely to have a normal pregnancy and less likely to have complications than one who does not. She is also more likely to have a healthy child and a good supply of milk for breast feeding.

No matter how good the mother thinks her eating habits are now, it will pay her to check her diet with the information about nutrition. She must choose the foods that supply her with the materials necessary for growth, for the repair of worn-out tissues, for the manufacture of energy and for her general well being. Each day her food must supply her with three different kinds of nutrients.

1. Proteins for the growth and repair of her body.
2. Minerals and vitamins for growth and to keep her body in good working condition.
3. Fats and carbohydrates for energy.

In a good diet, foods are combined to include all essential foods, in correct proportion to satisfy the nutritional requirements of the expectant mother.

The fluids are as important as the solid foods. Milk soups and fruit juices are very nourishing. She needs as much as two quarters of liquids every day, but most expectant mothers need to drink several glasses of water a day in addition.

If she lives in a place where there is not enough iodine in the soil, she may need to use iodized salt instead of plain salt in consultation with doctor. If advised by a doctor, she must also restrict salt in her diet.

2. Weight

She will certainly be heavier towards the end of her pregnancy than when it began, but she should regain her normal weight after the baby is born. The average full time baby weighs between 3.2 to 4 kg. The placenta and membranes weigh about half kg, the enlarged uterus about one kg. There will also be some increase in the size of the liver and the volume of the blood. The body tissues will absorb and hold more water. These normal increases usually add up to 5.5 kg.

Many physicians recommend a total weight gain of about 9 kg. A sudden gain of several pounds over a short period of time should be reported to the doctor.

3. Rest and sleep

Though an average of 8 hours is required for sleep, there are individual differences also. Rest periods during the day help to conserve energy. These day time rest periods can be short, and still beneficial if she really relaxes. It is also refreshing to sit down several times during the day with the feet up. The employed women can do this soon after lunch or when they get home from work.

4. Exercise

A moderate amount of enjoyable exercise will be good during pregnancy. It helps in digestion and blood circulation. It helps to develop the muscles and give them tone. Some time can be spent out of doors everyday. Most of us are so used to cars and buses and we forget how pleasant it can be to walk to the market or friend's houses. Gardening is an excellent way of getting fresh air. Heavy lifting, pulling or pushing around of heavy things must be avoided.

Work under pressure is more tiring than work done more slowly with frequent short rests. If the indoor work is too strenuous, it will be better to rest in the open air in good weather.

5. Clothing and personal hygiene

After four or five months, the pregnancy will begin to show. The waist bands will seem tight and nothing you put on will feel just right. If one wears saris, she will not have to bother much about a special dress because sari is a versatile garment which fits any size. The skirt of a modern two-piece maternity suit has an extendable belt and an elasticized section in the front panel

under the smock. If one wears Western style dress, this is the time for wearing clothing designed for expectant mothers.

There is no reason for any woman to wear ill-fitting dress. She must particularly be well at this time, if she takes a little trouble to find colours and styles that suit her. Panties should be loose enough to adjust easily as the waistline expands. Some have special sections of soft elastic in front. It is important to wear a good supporting brassiers from the beginning of the pregnancy. Girdle can be used if the doctor advices.

Properly fitted shoes, sandals or chappals with flat, low or medium heels will help to balance the walk. A bath every day will be refreshing and relaxing. It is customary for an expectant mother to see her dentist soon after she becomes pregnant. If there are cavities, they should be filled to prevent further decay. Sometimes during pregnancy, the gums become redder than usual and bleed easily. Be sure to consult the dentist or the doctor if this happens. The difficulty may be nutritional. Mouth infections should be cared for immediately.

About the fourth month, a colourless fluid called colostrum begins to ooze from the nipples. This means that the breasts are preparing to produce milk. If this secretion forms a crust, use little cream or linolin to soften it. Small squares of gauze worn over the nipples will keep the colostrum from coming through into the clothing. If a breast or nipple becomes sore, hard or inflamed, the doctor must be immediately consulted.

6. Travelling

Some people think that travelling during the early stages of a pregnancy may cause miscarriage. There is no evidence to support this belief. Late in pregnancy, however, it is wise to limit travel, chiefly because, on a long trip, labour might start at an inconvenient time. If a long journey after the seventh month needs to be undertaken, the quickest and easiest way must be undertaken.

7. Feelings about pregnancy

Studies of pregnancy show that some women are overjoyed, the majority have mixed feelings and some are definitely not pleased. As the weeks pass the woman thinks more and more about the pregnancy and looks for more reassurance especially from the doctor and extra attention from the husband.

In general, the women whose pregnancies are the smoothest, from the emotional standpoint, are the women who learn as much as they can about the facts of child bearing and child birth, ask questions when something comes up that they don't understand, share their feelings with their husbands, stick to a good health routine, have fun and follow the advice they get from the doctors. When your doctor feels that you should be less active physically, spend more time on some of the quieter things you enjoy doing. For mothers who knit, the new patterns and yarns for baby things can be a source of great delight. You may sometimes prefer to be alone, to read or just to do nothing. This is fine; give in when you feel tired. Nature has a way of slowing you down when you are carrying a child, as if to remind you that you need to be quiet in order to gain strength from your own inner resources. At the same time every pregnant woman needs some companionship.

Postnatal care

The first few hours after the baby's birth are very busy ones for him. His lungs fill with air in order to supply his body tissues with the oxygen they need. If he has any trouble in breathing because of mucous in his lungs, throat or nose, the doctor or nurse will help him get rid of this.

The umbilical cord is cut and clamped or tied off. Some doctors put a dressing on the small piece of cord that remains attached to the baby's naval, some do not. This reminant of cord dries up within a few days and drops off after about a week. In some hospitals, drops are put in the baby's eyes. The medicine

is usually either a one per cent solution of silver nitrate or penicillin. This is precaution against certain types of eye infection.

1. Feeding the baby

The baby is brought for his first meal sometime between 12 and 24 hours after birth. Whether the mother plans to breast or bottle\feed him, you will need to help him learn how to use a nipple. Breast milk is a natural food. It has in it most of the food elements a new-born baby needs for growth. One of the important reasons for breast feeding is the contact with his mother's arms and body, the feeling of warmth, closeness and security a baby gets from being held while he takes this food. The bottle fed baby can have this security if the mother holds him in her arms to feed him just as she would do if she were breast feeding him. As a baby drinks, bubbles form in his stomach. This is a normal part of his digestion, but it can make him uncomfortable. The mother must hold him up against her shoulder or ask the nurse to do so, then pat his back gently, so that he can bring his bubbles up. Another way of 'burping' is to make him sit on the mother's lap, his stomach against her forearm. With the other hand, she can stroke upward on his back to help him push the air out of his stomach.

2. The baby's bath

Most hospitals give sponge baths with soap and water to new babies. The baby may not be bathed for several days, although the folds of his skin may be cleansed with mineral or baby oil on cotton balls. Surgical gauze is not used for sponging the skin of a new born. It is rough in texure and apt to be irritating.

Most babies get their first real baths on the seventh or eighth day. Proper baths are delayed until the stump of the cord has fallen off and the naval is healed. Whenever the diaper is changed, the region around the genitals and buttocks should be carefully cleaned with baby oil or warm water and mild soap. The baby's skin may become dry and scally, but this is nothing to worry about. It is a condition that usually corrects itself as the baby gets older.

3. Clothing for the newborn

Buy or make as little as you can at first . A minimum list of clothing may include two to three dozens of diapers, one dozen shirts, four bonnets, six bibs, one dozen cotton sheets, two water proof pants and sheets, two woolen sets, two flannel shawls and four night gowns.

Diapers should be soft, absorbent, light in weight and not bulky. Babies do not like to be either too warm or too cold. They will fuss if their clothing is too heavy, too hot or too tight. They need to be able to move their bodies freely, especially their arms and legs. The baby's head need not be covered, unless he is taken outdoors on a cool or windy day. A padding around the sides of his cane basket carriage or crane will usually be enough to keep off a drift.

In addition to all these, the mother must continue to take care of herself by taking nutritious diet and by keeping herself clean as she did during pregnancy. The instructions given by the doctors must be followed carefully for the health of the mother as well as the baby.

CARE OF THE INFANT

For a healthy foundation the care of infants starts even during pregnancy. Child care is receiving great attention due to the scientific concepts introduced in it all over the world. It is a must for all the parents to have clear cut understanding regarding the proper and adequate care to be given to infants. The important areas of infant care are feeding, bathing and clothing.

Feeding infants

Well-fed children are active, pleasant, cheerful and healthy. The ill-fed ones are thin, weak, irritable and lethargic. There are different kinds of milk available in the market such as 'Glaxo',

'Dumex', 'Lactogen' and the like in addition to human milk, cow's milk, buffalo's milk and goat's milk.

Human milk

Mother's milk is the most natural and ideal food for the baby. It is always pure and the baby cannot catch an intestinal infection from it. Psychologically breast feeding gives the baby a feeling of safety, protection and love and the mother a sense of accomplishment. The composition of breast milk best suits the human infant's digestion and rate of growth. The protein and fat in human milk are much more easily digested and absorbed than those of cow's milk. Further, human milk is available at the proper temperature. The mortality rate is high in artificially fed children especially in the lower economic classes.

From a purely practical point of view, it saves hours of time every week, because there are no bottles to sterilize, no formulas to mix and cook and no bottles to warm. Of course breast feeding saves money too.

Cow's milk

This is the most common substitute for human milk. It must be used with suitable dilution. To every four ounces of diluted cow's milk, one level teaspoonful of sugar should be added to make the milk more sweet, as cow's milk has less sugar than breast milk and dilution further reduces the percentage of sugar. The dilution varies according to the age of the baby. During the first month, it is one part of cow's milk to two parts of water. Upto the third month, the proportion is equal parts of water and milk. From the third month till the twelfth, the water is gradually reduced and the milk content in the food is increased. At one year undiluted cow's milk is given. The milk is boiled well to kill the germs.

Weigh the baby and calculate the number of calories required on the following basis.

The caloric requirements of a child below one year are:

0-12 months - 120 calories/kg of body weight

Above 1 year - 1200 calories

The protein requirements are:

0-3 months - 2.3 g/kg. of body weight

3-6 months - 1.8 g/kg. of body weight

6-9 months - 1.8 g/kg. of body weight

9-12 months - 1.5 g/kg. of body weight

Thus a three month old baby weighing 5 kg. would require approximately 450 calories of food in twenty-four hours, to be given in the form of a litre of modified or humanized milk.

Other foods given

In addition to cow's milk, orange or tomato juice strained, sweetened and diluted is given to the baby as sources of vitamin C. Cod liver oil and vitamin C pills dissolved in water and a little iron may also be given for additional nourishment. Mashed bananas, free from fibres, mashed well in milk can also be given. But this must be started only after the fourth month.

Intervals of feeding

A new born baby needs to be fed every three hours. As its stomach cannot hold more than two tablespoonful of food at a time, it needs frequent feeds. A little later, when the baby needs six feeds a day, four hours schedule can be adopted. After the feed the baby starts sleeping quietly for few hours showing that it is satisfied with the feed. In addition to this the baby also gains weight from week to week showing the nourishment is adequate. By six months a normal baby's weight is two times of its birth weight.

Water must be given between feeds from a bottle or spoon and the interval is flexible.

If a baby does not grow in this way, a doctor should be consulted. Another way of judging whether the food given is agreeable to the baby is by noticing how he behaves. If he sleeps well and seems happy and comfortable, digests food, drinks adequate water, shows eagerness to have plenty of food, has regular bowel movements and passes plenty of urine, then rest, assures that the nursing is successful.

Weaning: The eruption of the first tooth is usually considered as an indication to start the weaning. It must be done gradually and can be completed by nine months. In our country in the rural areas and low economic conditions it is still prolonged due to the tradition and lack of scientific concepts. Bottle feeding can be introduced even before six months of age which will enable smooth completion of weaning.

The change from breast-feeding to complete artificial feeding should never be made in less than two weeks, except for urgent reasons. It should preferably take five or six weeks. Avoid weaning in very hot weather, if possible. While weaning, begin feeding the baby in a cup or spoon. The following are some suggestions for weaning the child step by step.

First week : Give wheat, ragi, oat or barley jelly by spoon at 10 a.m. Begin with one tablespoonful of the jelly followed by two or three tablespoonful of cow's milk and the usual breast-feed. Give breast-feeds as usual for the remainder of the day.

Second week : At 10 a.m. give jelly, increased to three to four tablespoonful followed by 12 to 16 ml of humanized milk. Omit breast-feeding at this hour.

Third week : Give breast-feed at 6 a.m., 2 p.m. and 10 p.m. only. At 10 a.m., 2 p.m. and 10 p.m. give humanized milk mixture. Give wheat, ragi, ragi

plus roasted bengal gram, milk, barley or jelly at 10.00 a.m. before the bottle-feed, and at 6 p.m. before the breast-feed.

Fourth week: Give breast-feed at 6 a.m. and 6 p.m. only. At 10 a.m., 2 p.m. and 10 p.m. give humanized milk mixture. Give wheat, or other jelly at 10 a.m. before the bottle-feed, and at 6 p.m. before the breast-feed.

Fifth week : Give breast-feed at 6 a.m. only and humanized milk at all other feeds. Give wheat, or other jelly before 10 a.m. and 6 p.m. feeds.

Sixth week : Discontinue the breast-feed at 6 a.m. also. Give 16 ml. humanized milk instead. The baby is now weaned.

In addition to these, the baby must also be given orange juice or tomato juice, strained and diluted with water, beginning with two teaspoonful and increasing to three tablespoonful once a day between feeds. Water must be given at least four times a day between the regular feeds.

Whether the baby is weaned at the ninth month or still suckled, some dry, solid food, such as the crusts of bread or dry crisp toast, should be introduced into his dietary at about this time, so as to train him early into the habit of chewing and thus induce, without delay, a proper flow of saliva. This solid food would also exercise the teeth. It should form part of the meal and be given about ten minutes before any milk is given. These activities lead to an increased flow of blood to the region of the mouth, which promotes the growth and development of the jaws, teeth and the roof of the mouth.

Choice and care of the feeding bottles

The feeding bottles should be heat resistant and transparent. Bottles with openings at both ends enable proper cleaning. If they are with one opening, the mouth, neck and bottom should be

large. The side should be smooth, rounded and without ridges. Nipple should be of rigid and tough rubber with neither too small nor too large holes.

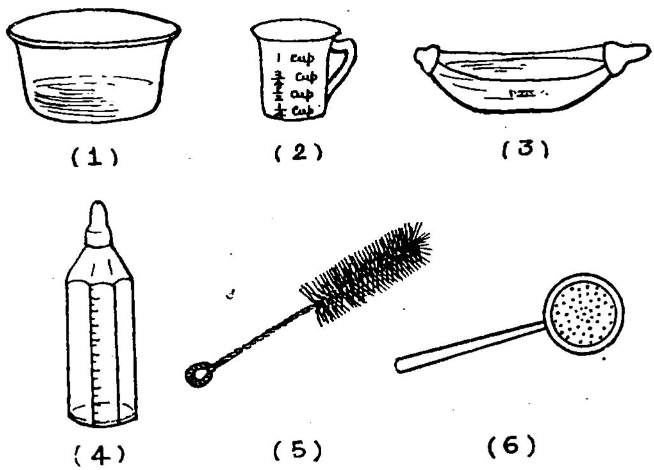


Fig. 44

Equipments used for infant feeding

1. Boiling Pan 2. Measuring cup
3, 4. Feeding Bottles 5. Brush 6. Filter

All the articles used for feeding must be cleaned soon after use and properly stored. Any oily matter in the feeding bottle can be removed with soapy water. Boiling the feeding bottle everytime after use is an ideal practice. The nipple and the bottle should not be exposed to dust and dirt. The bottles can be immersed in water and covered and the nipples must be kept in a closed container.

In addition the mothers and nurses must take great care of their own personal cleanliness. Before touching the feeding equipment, they must wash their hands properly. As children do not have much resistance to illness, this precaution is essential.

Bathing the Baby

All healthy babies are fond of bathing. It is desirable to give a bath everyday in warm water in cold climate and twice a day in warm climate. The temperature of the water can be of 37.8° C to 40· 6° C. Oil baths are good and have a cooling effect on the baby. The bath should be given very carefully and systematically. Set aside a particular time for bath, preferably before feeding.

Before taking the baby for the bath, all the required things must be kept ready within reach, especially the basin or tub or the pan, soap, a pitcher of water, change of dress and powder. Lukewarm water and mild toilet soap are preferred. The room must be large, well lighted and ventilated.

In India, the babies are laid on the mothers' laps or outstretched legs or planks and in some homes inside a basin or tub in western style. While bathing, the neck and back must be supported well. After applying soap rub gently to stimulate circulation and rinse it off throughly. While washing the head, see that the water does not run down the baby's face. For oil bath green gram powder is commonly used.

Use a soft towel to dry the baby and twisting the corner like a wick, the mucous from the nose can be removed. After thorough drying, toilet powder may be sprinkled lightly between the folds of the baby's skin, especially the axilla, elbows, neck, back of knees, groins and buttocks.

Dress

Preparing sets of clothes and napkins before the delivery is desirable, but some parents avoid doing it, due to superstition. As there is no difference in the dresses of boys and girls at this stage, they can be prepared beforehand.

While selecting clothes, his age and climate have to be considered. Light clothing is preferred in warm climate and warm

clothing in winter. Cotton is best for all the garments which come in direct contact with the skin. The woollen garments such as sweater and cap can be used in cold climate. Clothes in general must be thin, smooth, durable, soft and washable.

While making garments, avoid elaborate frills, as babies do not feel comfortable with them. They should be loose enough to allow enough freedom and movement of the limbs and enable free circulation or breathing. They must be easy to put on and move without any discomfort. Front opening is desirable as back buttons press the baby at the back while lying down. Draw strings at the neck need to be avoided as they may strangle him while being pulled. The clothes must be well stitched with strong seams, attractive colour and designs.

The diapers or napkins prevent the soiling of bed clothes. An oblong diaper 36" long by 18" wide are best suited. It is wrapped about the hips and between the limbs in the form of drawers. The ends are either pinned together or tied up in a knot which is easily untied. Diaper material should be of soft absorbent cotton and not of bulky or thick texture. It must be removed soon after the baby urinates or has a motion and a fresh one used. They should be kept clean, washed regularly, and dried in the hot sun on a line. Soiled napkins should be put into a covered pail and later on taken out and washed. If the napkins smell strongly of ammonia, they should be properly boiled and dried before use.

Napkins should not be tied too tight around the baby's waist or they may hurt his tender skin. Rough or dirty diaper will cause diaper-rash or reddening of the skin around the groins and buttocks. They may even cause sores and blisters. After removing a wet napkin, the wet parts of the body covered should be gently wiped with a soft cloth before a new one is tied or pinned on.

In hot weather, a napkin is enough clothing for a baby with a thin cloth spread over the chest. Special care must be taken while changing napkins at night, since carelessness will affect

the child's health. Wet napkins can cause a cold and lead to more serious infections such as bronchitis and the like. When a child is trained in toilet habits, the diaper may be substituted with drawers. The drawer should neither be too tight nor too loose and should be of soft material.

A baby's shoes give protection to his feet and make him look attractive and well dressed. During the crawling stage, they protect his tender feet, especially if the floors are rough. The shoes used should be roomy and not so tight as to cramp his toes. They should be of soft leather, without heels and be shaped exactly like the foot so as to fit comfortably. Socks, when used should be of soft material.

IMMUNIZATION

From time immemorial, infectious diseases have been the main cause of child morbidity and mortality. Immunization is the most practical way of preventing a disease. In our country this is easier said than done. Majority of the people are steeped in ignorance, fears, fads and superstitions. Rapid growth of population, lack of education and recurrent ill-health constitute further handicap in the path of mass immunization.

In spite of all these handicaps, the spread of the cult of immunization is gaining momentum and national programmes assisted by WHO have been started for the eradication of small pox, tuberculosis and cholera. In India today, we have facilities for immunization against small pox, tuberculosis, diphtheria, portussis, tetanus, typhoid, cholera, polio and rabies. Measles vaccine is under field trial.

Immunization has many advantages. In rare cases, a person may get disease in spite of immunization. When this happens, only a mild form of disease is contracted. It is much cheaper to prevent the disease than to pay for the cost of medicines and doctor's fees in curing the disease. When you consider the pain,

misery and the danger to one's life during an illness, there can be no two opinions about immunization.

Most immunizations are divided into two phases. The primary or the initial immunization consists usually of one or more injections to build the immunity required. As time passes, the immunity decreases and it becomes imperative to boost it for better protection.

The secondary immunization, or the boosters are given after a time lapse to build or boost the immunity in the body. Unfortunately, many people who take and are aware of the primary immunizations, completely forget about the boosters or secondary immunizations. The fault lies partly with the medical profession, which needs to educate the public about the need for boosters. Parents, too, forget to give the additional protection to their children. When the child is small, they are very conscious about matters like immunization, but as time passes they postpone the booster injections to a convenient time and this needs to be avoided.

The immunization rate in the child population of our country is far from satisfactory. It is difficult to give any percentage figures, but we have a large population of children who have not received even primary smallpox immunization. In spite of active efforts by the central Government, the State Governments and Local Bodies, a large number of children still remain without protection against TB. The immunization rate with other antigens is poorer still. Any worthwhile immunization exists only in the urban areas. A large proportion of children living in the villages do not get the benefit of most of the antigens.

There is no hard and fast rule regarding the ideal age for immunization as it depends to a large extent upon the prevalence of the particular disease and its severity in a given community. The precedence should be given to antigens against infections with a more serious outcome. Susceptible children should be protected at as early an age as possible without waiting for the age at which the vaccine will produce its maximum response.

Protection offered at any age is better than no protection if the child has not been brought in time.

Recommended Schedule of Immunization by Tibrewala and Pai 1971

1. BCG—first week of life and then every five years, upto the age of 15 years.

2. Smallpox—first week of life and then every 3 years.

3. D.P.T.—3, 4, 5 months; 1st Booster at 2 years and 2nd Booster at 5 years of age. Subsequently Diphtheria and Tetanus Toxoids—once in 5 years.

4. Poliomyelities—3, 4 and 5 months 1st Booster at 2 years 2nd Booster at 5 years. Subsequently in the case of epidemics.

5. T.A.B—at 2 years and then yearly.

6. Cholera—at 2 years and then every 6 months.

7. Measles—once only between the age of 9-12 months.

The above schedule is recommended as the one most practical under our existing conditions. In case the primary immunization with the above vaccines has been carried out at a later age period, the booster doses should be given at correspondingly later dates. However, any immunization programmes has to be a dynamic one to suit the changing condition of the area and prevalence of any particular disease. It is imperative to review the programme frequently and to adjust it to the changing needs of the society. It may be re-emphasized here that no immunization is 100% effective and fool-proof.

All medical and paramedical persons should receive proper training in all immunization procedures, their untoward effects

and methods of minimizing and combating the same and in the ideal ways of storage and transport of vaccines.

Health education, propaganda-leaflets, handouts, regular radio talks, cinema slides, talks at places of worship and mass rallies, immunization charts and pictures at every hospital, primary health centres, maternity homes, dispensaries, schools, factories and industrial concerns will help in preparing the people in being receptive to the idea of immunization and will naturally make the task of the team for immunization easier.

Further success of immunization programmes could be obtained by ensuring that all these procedures are carried out compulsorily at school level before admitting the students to the school. Booster doses should be given where the child is already immunized.

Everyone concerned with immunization should familiarise himself with the problems of availability, storage, transport, finance and administration of vaccines at various levels. As certain vaccines maintain their poteny at certain temperatures, it is essential that these vaccines are transported and stored at the required temperature.

HABIT FORMATION

Habit is a set pattern of behaviour that is consciously or unconsciously learnt. As habits are learnt by repetition, they become automatic and spontaneous. Once they are formed, they do not require much effort and concentration. When a way of behaving is well learnt to the point of being automatic, the behaviour is a habit.

Importance of habits

Proverbs such as 'What is not bent at five cannot be bent at fifty" and "cradle habits persist to the grave" explain the importance of habits. Habits learnt during early years become part of the individuals life. They dominate our lives. Much of our behaviour

consists of habits—eating habits, dressing habits, speaking habits, habits of punctuality and all our routine are the result of habit formation. Our behaviours is the result of accumulation of habits. Habitual response is the easiest and quickest way of adjusting to situations.

Habits are related not only to the way of acting, but also thinking and feeling. For example, children learn not only to put on garments but also certain colours and dislike others. They develop habits of 'good taste', 'neatness', 'daintiness' or 'hard work'; even attitude towards life are partly a matter of habit. Children learn to be cheerful and happy or sulky and cross according to habits they form.

Advantages of good habits

1. Habits are the basis for healthy and happy living. For example good habits of eating, sleeping, thinking and working keep us healthy and happy.

2. They form good character. Good moral habits lead us to respect and a great source of power.

3. They make our actions easy and more accurate due to day to day training.

4. They stabilise our social relationship.

5. They enable us to carry on with activities which were unpleasant at the first sight. For example speaking good language and being neat become enjoyable later.

Methods to be adopted in imparting good habits to children

1. Try to instil good habits in the child at an early stage as they are easy to learn. At a later stage it becomes difficult to learn.

2. Remember that the child will make many mistakes in the beginning. Practice alone will help him. Be patient when he learns by trial and error.

3. The child must be physiologically ready to learn a particular habit. Toilet training, writing etc. should not be started too early.

4. Consistency among family members must be maintained while guiding the child.

5. Guide the child in the daily routine. Regularity in guidance quickens the process of learning.

6. Parents, other family members and teachers must set a good example as the children copy their behaviour.

7. A congenial relationship must prevail at home and school. Get the trust and confidence of the child. Only then your instructions and guidance will be respected.

8. Judge the child's conduct on the basis of his general behaviour. Simple and rare mistakes need not be considered too serious.

9. When the child misbehaves, find out the cause first and handle him accordingly.

10. Be honest in your dealings with the child. Avoid telling lies.

11. Avoid giving commands and expecting obedience when it is physically impossible for the child. For example telling him to go to sleep right then or telling him that he must eat all that is served in the plate.

12. Avoid constant nagging and scolding.

13. All habits must have an element of satisfaction. Approval and encouragement are necessary along with occasional rewards. Avoid false promises.

14. Do not consider obedience as an end. It should only be a means to the end of achieving self control, social adjustment and consideration for others.

15. Consider individual differences. Do not expect all the children to behave in the same way. Beating a child by an unfavourable comparison with another needs to be avoided.

Some areas of habit training

The important areas of the child's life are feeding, toilet training, sleeping and play.

Feeding:

Regularity in feeding helps the child to learn good food habits. Vegetables and fruits must be introduced early before the child develops definite likes and dislikes. The family members need to set an example by not showing dislike to certain foods. If a child shows an innate dislike for certain preparation, the recipe has to be changed. Make meal time an enjoyable experience and avoid forcing him to eat anything. Do not expect the child to take full meal everytime. If he refuses to eat, wait till he gets the appetite. The child's food problems must not be discussed in his presence as they deepen his aversions. When he can feed himself, encourage him to be independent and give him time to eat without spilling. Regular washing of hands before and after eating must be encouraged consistently. If the child consistently eats less, consult a doctor.

Toilet training

The mother must put the child on the pot or pan or any other suitable place and train him to use the receptacle. By about one and half years of age the child has good control during day time and when they are three years old, they must have control during night also. The bowel training must be started when the child is

ten months old. Train him to sit on the pot for about 10 minutes at the time when he usually has his bowel movement. Early morning soon after he has had his first feed is the proper time. Slowly the baby learns to pass stools sitting comfortably on the commode.

Before going to bed see that the child evacuates bladder. If he wets bed regularly at night, wake him up just a little earlier and make him urinate. Avoid giving much liquid just before going to bed. See that the child does not suffer from emotional stress, nervous disability or undue fear. Avoid criticising or shaming him in case of bed wetting. Appreciate when he succeeds and be patient when he is learning bladder control.

Sleeping

Rest is as important as food and play. Babies need long hours of sleep. The new born sleeps almost the whole time. The six months old baby sleeps 16 hours per day will reduce to 15 hours at one year. There are individual differences also. Develop regular sleeping habits in the child. The home atmosphere should be calm before the child is put to bed. Any exciting incidence may affect his sleep. See that his bedding is comfortable. If he is wet or cold, or sweats profusely he is unable to sleep peacefully. Loud noises, mosquitoes or bed bugs are also the disturbing factors.

The baby must have a separate bed of its own. The baby must be relaxed and happy before going to bed. Do not rush him to bed. A child who is healthy, happy and comfortable in the bed room will have no problem in sleeping.

Play

The play materials and areas used by the child must be safe and free from disturbances. The toys need to be carefully selected for safety, durability and suitability. A separate play area strengthens the child's self importance and belongingness in the family. The shelves can be arranged at a low level to enable the child use them independently. Train him in the proper use of the equipment and also to keep them back safely in the respective places. Encour-

age the collection of attractive stones, shells, beads etc. and do not remove or meddle with the child's materials without his permission. This will help him to respect other's things and property rights. In case the child plays with others, the parent has to supervise it atleast indirectly to check that proper habits are developed and retained. Avoid spending too much of money for buying toys or dumping the area with too many play things. As the child grows his interests are specific and intense. This must be considered while buying new materials. Once he attends school, develop regular habits of play and study.

While developing all these habits, the psychological basis has to be considered and a positive and understanding approach will surely be fruitful.

THE PSYCHOSOCIAL NEEDS OF CHILDREN AND ADOLESCENTS

The infant at birth has only a few needs such as the need for nousrihment and a need for affectionate maternal care. But they grow in number and complexity as the individual. Recently psychologists, teachers and parents have started realizing that basic needs such as food, clothing and shelter alone are not sufficient for the wholesome personality development of the child. Every adult must have a clear understanding of the needs and the ways in which they need to be fulfilled to help the children grow up into happy and useful citizens. The discussions of the needs will show that no need can be isolated from the others as they are interrelated and independent.

Love

The child's need for love is very strong and has to be satisfied to minimise physical, emotional and mental maladjustments. As the family is the most important centre for the child, the parents and others need to outwardly show their love to the child and assure him that he is wanted in the family. The child learns to love parents, relatives and develops culturally favoured attitudes

through these identifications. These children can face the difficulties of life more readily than others. He smoothly learns his responsibilites and tries to do them to the best of his ability to please the persons around him.

Security

This is the mainspring of one's development. The child must get a feeling that all is well and he is cared for and is considered equally important as the others. This is built up when the mother fulfils this need for food, love and warmth. Through security, he develops a sense of well being, competence and self confidence. To enhance these, provide opportunities for success and failure need not be rebuked. When the child receives praise and appreciation from others, he starts liking himself.

Accptance

The parents need to like and accept the child and make him feel he is wanted in the family, for what he is. As Symmonds has pointed out "Good citizens, good scholars, good parents and good workers come from homes in which the children are wanted and accepted." The parents must respect the child's feelings and let him express them. They should not be disturbed when the child expresses negative feelings, but make it a point to accept and return positive feelings. They must have good communication with the children and listen to their problems. An unconditional love must be shown so that the children will become friendly and clear in their thinking.

Belongingness

The child interacts with others continuously and learns to be a co-operator, imitator, competitor, leader or follower at different stages. The child has an innate nature to be possessive and slowly develops a sense of pride about his play materials, other possessions, parents and teachers. He wants to belong to his family and school. It develops a sense of importance and satisfaction. Belongingness later on leads to identification with

parents, teachers, friends and others. Lack of such identification may lead to antisocial behaviour such as delinquency in later years.

Companionship

No matter how young a child may be, he needs companionship. He gets socialised and learns how to get along with others through the companions. He learns either to accept his own hostile feelings as he sees them in others or to control or express them in socially acceptable ways through the social interaction. As his peer group is a miniature society, he gets well-equipped to face the society, at a later stage. The companionship must be pleasant, healthy and well-supervised. The only child or the child with no playmates while young, finds it very difficult to develop competent social skills in later years.

Success

In early childhood, every child meets with approval or disapproval, praise or blame and success or failure. When he faces with more approval than disapproval, more praise than blame and more success than failure he develops a deep sense of satisfaction and self respect. If he is rejected he feels unloved, unimportant and inadequate. Consistent success combined with encouragement enables him to strive for higher achievement. Too easy and too difficult tasks do not give him a feeling of success. Irrelevant and too much of praise, may make him less competent than others. So the environment needs to be challenging coupled with intelligent adult guidance.

Adventure

The child explores the environment with the spirit of adventure. Due to lack of maturity to know of the dangers, he may approach the fire or the dangerous insects boldly. Instead of completely discouraging him, explain the consequences to avoid danger and at the same time, be adventurous and take small risks of falling etc. through free and spontaneous play. Excursions

excite the children as they offer numerous first hand experiences with nature, plants and trees. Adventure helps him to find out certain things and also invent certain games or imaginary play which provide joy and constructive ideas.

Independence

Independence helps the child to freely observe and understand the environment and people around him. This need must be fulfilled to a great extent with minimum of interference and control. An independent child is happy, sociable, self-confident, adventurous, bold and well adjusted. He is not unduly apprehensive or inhibited. When the child plays in a well planned and well protected environment with safe play materials he learns to play freely with his things and also replace them safely. Thus, he also learns to be responsible with minimum of dependence on adults. When the child has maturity and eagerness to do things by himself, give him more freedom to learn the task through trial and error.

Guidance and control

Guidance has a positive objective or preventive and remedial assistance. Control stresses on clear cut restrictions on behaviour. Tell the child what to do, instead of feeling what not to do. Avoid changing behaviour by methods which may lead to loss of self-respect. Use tone of voice and words which will help the child to be confident and reassured. Avoid unfavourable comparisons with other children. The children who have a clear idea of what is approved and what is not, are the happiest and most secure ones. Such children show relatively less confusion, negativism, quarrelsomeness, disobedience, aggression and fear.

The parents grow in their capacities along with their children. They need to understand the unique nature of each child and guide accordingly. Depending on the personality of the child and the environment, the nature and the degree of the needs change. Parents and teachers need to understand these dynamics and help children grow in joy, adjustment as well as achievement.

The physiological needs of adolescents

As pubescence is marked by rapid bodily changes bringing about primary and secondary sex characteristics, they are accompanied by anxieties, tensions and worries. However the physiological needs cannot be isolated from the emotional needs. Due to the rapid growth, the adolescent needs nutritious food more than at any other stage to come. As this stage is also marked by heavy physical activities, only the healthy adolescent can cope up with the demands of life.

In addition to adequate food, the health needs indicate that he also needs much guidance and counselling about his cleanliness habits. Every adolescent, fortunately is most interested in personal attractiveness and hence catches up any clean habit though it may not be very easy to learn them. The girls need very careful and methodical training from their mothers regarding the proper use of sanitary napkins and the toilets. Unfortunately in our country, we need to go a long way to imbibe the values needed for maintaining absolute cleanliness of toilets. Both the boys and girls need to be taught to be very neat and wear only clean underwears. Special attention must be paid to armpits and groins as there is excessive sweat and chances for bad odour. Further, the cleanliness habits in relation to teeth, eyes, nails, hair and skin learnt in childhood need to be strengthened and improved if necessary.

Sex education is a must before and during puberty. They need to be well oriented about the physiological changes taking place in the body so that they will accept them as part of growth and development without anxiety and embarrassment. Scientific knowledge about the other sex helps them to respect each other and not be motivated by unhealthy behaviour such as ridicule or aversion for the members of the opposite sex.

Parents and teachers must remember that the adolescent lives in a society marked by rapid social changes. He cannot and need not be kept in secrecy regarding the facts of life. By the good example of parents, teachers and other adults, he inculcates deep moral values and accepts sex as the desirable and normal

part of life. The parent of the same sex can clear doubts regarding sex matters in a calm, composed and scientific manner. If this is not done, the adolescent seeks information from the peer group, from where he may learn unhealthy attitudes. This brings about lack of trust in the parents.

It is unfortunate that some parents still think that sex education is harmful to youth. It may be due to lack of awareness regarding the scientific contents and the positive goals of sex education. As the adults are fully responsible to guide youth in all areas of life, this basic area can be handled by them very successfully, if they themselves have imbibed a scientific attitude towards it.

The Psychosocial and Emotional needs of Adolescents

Adolescence is described as a period of storm and stress. It is a period of bridging the gap between dependent childhood and self-sufficient adulthood. It is a period of leaving school, breaking away from parental domination, of vocational selection and adjustment, of establishing self-reliance, and self-responsibility in conduct, of sexual restraint, of social adjustment, in all of which the school situation has a larger influence upon the personality pattern than at any other time of life.

The adolescent is neither a child nor an adult and is developing a personality with more permanent characteristics. The needs of adolescents are very intensive as they have long lasting effects on their life. The adults who have to guide them must have a very clear understanding of these needs and provide opportunities to fulfil them. The major psychosocial and emotional needs are as follows:

1. Achieving emotional independence from parents and others

The adolescents desire to take up decisions by themselves and many a time feel that the adults do not understand them. Some of them are eager to take up part time or full time job to achieve economic independence also. The adults must give them freedom and at the same time maintain the loving relationship. A balance between independence and a mature kind of dependence must be achieved.

2. Developing satisfying and constructive relationship with peers

The adolescent needs to first understand oneself and accept the masculine and feminine role without any inferiority or resentment. He or she must accept people with different backgrounds, interests, abilities. One needs to look pleasant and attractive to peers of both sexes.

3. Need to prepare for a vocation

Having a job that is suitable and satisfying is one of the requisities of happiness. As a goodly share of one's waking hours every week is spent at work, one insures a large amount of the eye's success if one enjoys work. The adolescent needs to be guided to discover that work is pleasurable, make the most of work opportunities through proper alertness, develop qualities of perseverance, reliability and responsibility, understand one's temperamental needs as far as work is concerned and know the kinds of work that are available to one's own capabilities and interests.

4. Need to grow into a responsible citizen

He needs consistent guidance and good examples to develop qualities of character, neighbourliness, honesty, co-operativeness,

respect for the law, respect for the rights of others, interest in good Government and contribute his own efforts to the needs of his community. The adolescent observes the adult, questions his motives, weighs his values, imitates some of his behaviour and develops habits that will be of use to him in the world he is to enter. Hence the need for adults to set a good example.

5. Need to prepare for marriage and parenthood

Adolescence is the time when interest in the other sex develops. It is a time of romance, a time when thoughts of marriage take on reality, a time for viewing relationships in the home with newly critical eyes. Marital happiness depends greatly on the good personal adjustment of the two people involved in the marriage. One needs to be secure, fearless, unselfish, understanding, kind, loving, sympathetic and forgiving to achieve happiness and satisfaction in marital life. As adolescence is the last chance for improving oneself, he needs interested adults to guide him in this regard.

To achieve successful parenthood, one needs to be well adjusted in married life, have love for children and have knowledge about the needs of children. In a happy family this need is automatically fulfilled to a great extent.

6. Need to fulfil personal interests

The adolescent is greatly interested in himself. He is worried about his appearance and the impression he makes on others. His main concern is his status among his peers. Interest in appearance covers not only clothes and personal adornment but also every aspect of appearance. Hair, body size, facial features, skin and nails are all focal points of interest to him. As the adolescent's

happiness and self confidence depend upon his contemporaries' attitudes towards his clothes, he is anxious to conform to what the group approves of in the matter of dress. It may look unimportant to adults, but they must respect the adolescent's interest and must not think that he has superficial values.

7. Need for fulfilling religious interest or thirst

Adolescence is a time when there is a religious awakening, a time when childish religious beliefs are examined critically, evaluated and then revised to meet their new and more mature needs. All of this takes time. Critical examination of his childhood beliefs is often followed by doubting. Absence of religious doubt is an unhealthy sign. Those who do not have the courage to doubt may not acquire the wisdom to believe. The religious observances of home have little appeal to the young adolescent. Only under unusual circumstances such as at the time of important examination, will most young adolescents engage in prayer as a meaningful personal experience. The adults have to be understanding and fulfil his need by inculcating deep religious and moral values which are applicable and meaningful in his total psychosocial and emotional contact.

8. Need to imbibe positive emotions

The adolescent must be free from apprehensions, fears and anxieties in his relationship with people and in regard to what the world would do to him. He needs guidance in welcoming new experiences without fear, in developing confidence in his own abilities, in being forgetful of self without undue restrictions. He must be good humoured and little dependent on anger. He must become an adult able to forget himself in his love for others. He needs to be too intelligent about his emotions to be mislead

by them. Appreciation of aesthetic experiences such as nature, poetry, novels, painting, sculpturing, music, play and movies stimulate the highest and best feelings in him.

9. Need for recreation

Only satisfying recreation contribute to happiness and physical as well as mental health. Adolescent recreations set the pattern for recreations in adult life. Whether the needs of the adolescents will be met or not depends on what recreational activities are available, what his attitude towards them is, and how well accepted the adolescent is by the peer group that dominate the recreations. Recreations supply the exercise necessary for good health and reduce the emotional stress. They are socially approved outlets for aggressiveness, offer opportunities for self expression in creative activities and offer relaxation that eases the tensions of everyday life. The recreational interests are numerous and the interests vary in different culture, socio economic backgrounds, and environments. Within the limitations of the family, school and community, the adolescents must be helped to enjoy them.

10. Need for attaining the behaviour directives of adulthood

The period of adolescence offers maximum motivation for the adolescent to develop many behaviour directives which will be useful for future life. They need to make different ideas, view-points and values as part of their personality in terms of attitudes towards laws, attitude towards spending and saving money, ideas as to the purpose of life, ideas as to women's working and women's place in the home, view points on social problems, values of morality, political views and basic philosophies in all areas of life.

In conclusion one must remember that the number, nature and intensity of needs differ according to the individual's personality,

the home background, the goals of life and the values held by the adolescents. The parents and teachers who have genuine love and consideration for the adolescents contribute greatly in fulfilling these needs. The adolescent must be helped to think independently and take up decisions for himself. In a healthy socio-emotional context such freedom always brings about the best results.

Different recreational interests of adolescents

Adolescents have many and varied leisure time interests that range from large-group recreational and entertainment projects to small group or individual participation in relaxing and intriguing types of performance. Their interests are continuations of childhood pursuits but many are new. They show selective and specific interests in their choice of books, magazines, radio, by the things they collect and the movies they see.

During late childhood, the children engage in a great variety of activities. But gradually some games and amusements are dropped and others centered upon until the last years in high school. And this pattern of interests becomes more stable during the teens.

Most of the adolescent's leisure time interests are shared with others. Social activities such as picnics, excursions and trips help to broaden vision. These activities affect the individual as a member of the group, by developing respect for rules, fair play, ability to subordinate the selfish interest of the individual to the welfare of the group and a spirit of team play and experience in the role of leadership.

Both sexes actively engage in games and sports throughout early adolescence. There is definite interest in games and athletics during adolescent period. This may be because of full amount of physical energy available and also due to the interest in the own body and its development.

Dancing and social affairs have an increasing appeal in adolescence. Interest in music is almost universal among adolescents and most of them collect phonographic records to which they listen, as they do to music on the radio. Environmental encouragement and stimulation greatly influence interest.

For both boys and girls of high school age, movies are generally ranked high among the favourite recreational activities. Both sexes remain interested in films. Boys show an increased interest in comedies and girls in love stories.

Young people spend many hours in reading their favourite newspapers, magazines and books. In an experiment by Paul, it was found that adolescent's interests in reading newspapers increased in illustration, radio news, war news and decreased in sports, travel, school news, college news, market news and labour. Boys prefer science and invention and girls show a preference for romantic stories.

Youth displays a keen interest in collecting various objects such as stamps, coins, match box covers, books on various subjects or proverbs or poetry.

Adolescents take delight in naming birds and animals. They love them, fondle them and are friendly with them. Craft and other hobbies give relief from boredom and they derive deep satisfaction from doing and exercising their creative faculties.

Many families spend their leisure time together with adolescents and join in such recreational activities as swimming, games or excursions. The school-going adolescents, have no doubt more facilities for recreation as the school generally makes provisions for different types of games, music, painting, poetry and others.

Through the house, school and youth organisation, the parents, teachers and other adults need to provide opportunities for wholesome recreation. The satisfactory use of leisure time may demand

facilities and opportunities in the community to meet the needs of the individual. The government machinery must give necessary help by providing adequate play grounds and the required technical assistance.

PLAY INTERESTS OF CHILDREN—THEIR IMPORTANCE

Play is a pleasurable and spontaneous activity of young children. It is an expression of the inner drama of the mind and is the way the small child discovers how to use the world for his own purposes. It is the dynamic tool for learning, growing and the integration of experiences.

Active play is essential if the child is to develop his muscles and exercise all parts of his body. It helps the child to work off excess energy and is an outlet for his feelings and this energy may be channelled into helpful activities. Play provides the greatest opportunity for every child to nurture, exercise and develop his innate powers and possibilities for the good of the future. It is the surest guarantee for the healthy development of our children.

Play is the key which opens the door to vast opportunities for the child's development like co-ordination of finger muscle, dexterity and co-ordination of eye and hand movements. Play is a serious absorbing task through which the child builds his body and refines manipulation.

It offers an outlet for a child's natural instincts and emotions. Phantasy play serves as an outlet for anxieties and tensions. It promotes the child's skills, cultivates his senses and above all helps him to train his imagination facilities.

Without play the child becomes selfish, self-centered and domineering. Feeling of sympathy and understanding develop in a child during group play. By playing with others he also

learns how to establish social relationship with strangers. Thus he becomes more sociable and successful in later life.

The child finds self expression through imitation, construction and phantasy. Spontaneous play promotes the cognitive development of the child.

Play is a child's way of learning and toys are his learning tools.

Suitable play materials for young children

The following is the criteria for selecting toys and other play materials for children.

1. They must be simple.

2. They must be safe and free from

   (a) sharp edges,

   (b) broken parts and

   (c) poisonous or running colours.

3. They must be washable.

4. They must be long lasting.

5. They must be large enough to be held easily by children.

6. They must be suitable to the child's age.

7. Provide only one or two toys at a time. Change them when the child loses interest in them.

8. They must have multipurpose.

9. The price should be moderate.

10. The child should be able to handle them freely.

The different types of toys and play materials are rubber balls, rubber animals, birds, beads, rattles, wooden spoons, spools, small pails, bells, blocks, sticks, shells, stones, seeds, broken (but safe) old household articles, chalk pieces, drawing boards and slates.

STORIES AND SONGS FOR CHILDREN

Stories for children

Children gain not only the specific pleasure of the story and characters, the vicarious experience of living through the events, they gain added experience of being it all as the author himself did. The stories from the old Hindu mythology, from the epics, the Ramayana and the Mahabharata have an inexhaustible supply of knowledge on Indian mythology while listening to them. Stories which revolve around daily life make it possible to understand different relationship with father, mother, brother and sister. If they are fairy tales, they tell of different types of men and women, kind and unkind, honest and dishonest, simple and clever and prepare him for the world as it is. When children listen to and narrate stories, their power of speech, style of expression and a mental exercise by thinking are developed.

Children's books help tremendously in character formation and a sense of responsibility. Children use good books as spring-boards for their imagination to gain the ability to interpret experiences and insights to the solutions of their problems.

Selecting stories for children

The child prefers to hear about things that belong to his environment, that have had to do with whatever he sees or hears or handles. The themes of stories should be simple and close to their everyday lives such as cows, pigs, chickens, horses, cats and dogs. Fairy tales should be in moderation to make interest in real people and things and later adjusting to the world. Storie; must be within the understanding of children. They must have auditory appeal, intellectual content and emotional suitability for entertaining.

Songs for children

The elements of music, sound and rhythm are woven into a baby's life from the very beginning and gives the children a chance to become familiar with a number of themes. Music helps children to experience the emotions of people of other times and places. It brings joy and enhances rhythmic dramatic play. Music holds a special blessing for children who move awkwardly and for shy children. Under its stimulating influence muscles seem to loosen up and co-ordination increases as self consciousness tends to fade.

Selecting songs and song books for children

Children's songs should be simple and easy to sing. The words should be familiar ones expressing familiar ideas. They must have repetition and be pleasing to the children. The songs should be very short at first and long then as children mature. The types of songs children like best vary according to their major interests at that time. As the child grows older there is an increased interest in classical, folk and patriotic songs. There is less interest in religious songs and increased interest in popular and dance music. Songs are good if the rhythm is smooth and flowing and if the song is of permanent value.

While teaching songs, it is necessary to include a broader range songs and rhythms, putting more emphasis upon musical

techniques, encouraging the creation of original songs and providing opportunity to listen to music. The songs should be clearly and accurately presented. The songs should be sung within the vocal range that is easy and natural for the child, so that he has feeling of satisfaction, pleasure and success, developing knowledge, giving information, stimulating imagination, relieving emotional tension and building character.

Life stories of such great men as Mahatma Gandhi, Swami Vivekananda, Abraham Lincoln, George Washington, inventors like Thomas Alva Edison, the Wright brothers and galaxy of other well known potentialities and the story of animals, plants, flowers, mountains, oceans, rivers, volcanoes, the solar system could be very interesting for children.

While telling stories the adult must speak slowly with emphasis on important words and appropriate facial expression. Use simple words. Charts, books, pictures, or models can be used alongwith. The children's questions must be adequately answered. Children must be encouraged to tell stories of their own. When the adults have a relationship of trust and affection with children, there is no need to worry too much about the techniques of story telling.